MITSUBISHI

Mitsubishi Industrial Robot

RH-3FH/6FH Series

INSTRUCTION MANUAL

ROBOT ARM SETUP & MAINTENANCE

MELFA

BFP-A8865

⚠ Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

⚠ CAUTION

All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
Enforcement of safety training

⚠ CAUTION

For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
Preparation of work plan

⚠ WARNING

Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
Setting of emergency stop switch

⚠ CAUTION

During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
Indication of teaching work in progress

⚠ WARNING

Provide a fence or enclosure during operation to prevent contact of the operator and robot.
Installation of safety fence

⚠ CAUTION

Establish a set signaling method to the related operators for starting work, and follow this method.
Signaling of operation start

⚠ CAUTION

As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
Indication of maintenance work in progress

⚠ CAUTION

Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
Inspection before starting work

The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

⚠ CAUTION	Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)
⚠ CAUTION	Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.
⚠ CAUTION	Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.
⚠ CAUTION	Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.
⚠ CAUTION	Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.
⚠ CAUTION	Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.
⚠ WARNING	Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.
⚠ WARNING	Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.
⚠ CAUTION	Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.
⚠ WARNING	When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.
⚠ CAUTION	Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.
⚠ CAUTION	After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.
⚠ CAUTION	Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.
⚠ CAUTION	Never carry out modifications based on personal judgments, or use non-designated maintenance parts. Failure to observe this could lead to faults or failures.
⚠ WARNING	When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

⚠ CAUTION

Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF. If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected. Moreover, it may interfere with the peripheral device by drop or move by inertia of the arm.

⚠ CAUTION

Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters. If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters, the internal information of the robot controller may be damaged.

⚠ CAUTION

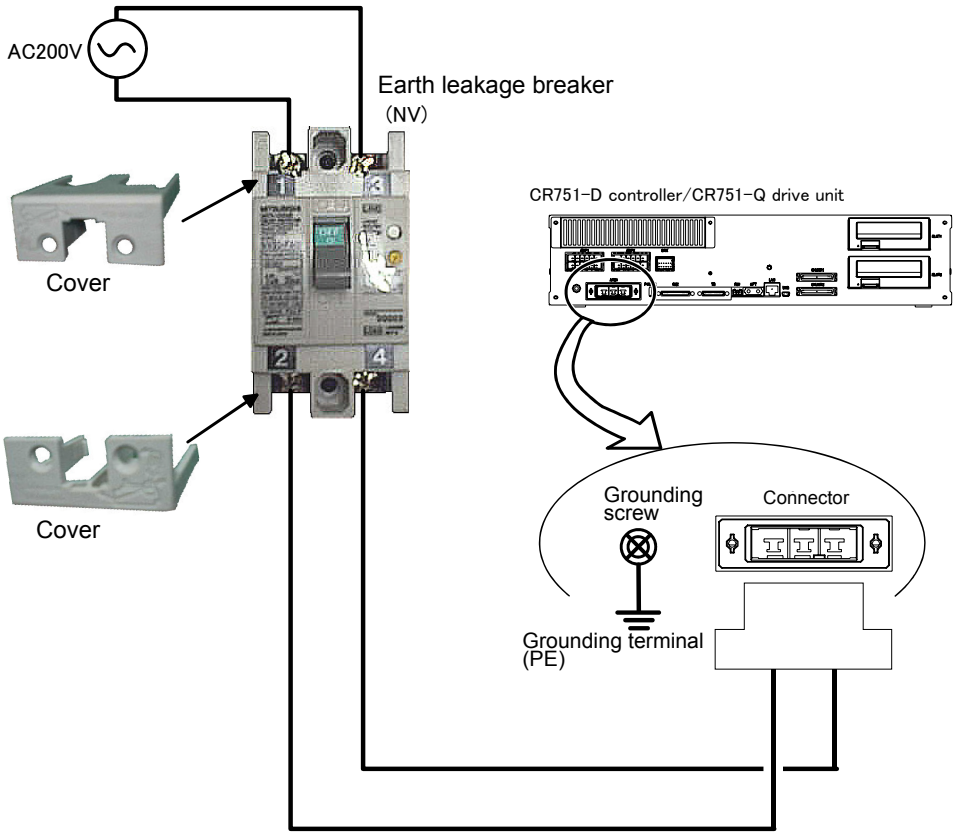
Use the network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB. When using network equipment, measures against the noise, such as measures against EMI and the addition of the ferrite core, may be necessary. Please fully confirm the operation by customer. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

*CR751-D or CR751-Q controller

Notes of the basic component are shown.

⚠ CAUTION

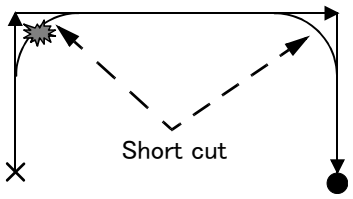
Please install the earth leakage breaker in the primary side supply power supply of the controller of CR751-D or CR751-Q because of leakage protection.



⚠ CAUTION Be careful of interference with peripheral equipment.
Especially don't give a shock to the shaft (J3 axis). When you install the hand, be careful not to knock at the shaft end by the hammer etc. The shaft may be damaged.

Take care also of the following items.

(1)The robot's locus of movement may change with specified speed.
Especially as for the corner section, short cut distance may change. Therefore, when beginning automatic operation, moves at low speed at first, and you should gather speed slowly with being careful of interference with peripheral equipment.



Arch movement (example)

(2)It can be confirmed whether the specified position exist in the defined area by using the instruction command "Zone". It can utilize as one of the methods for collision evasion. Refer to the "detailed description of the instructions manual/function, and operation" of the separate volume for the details of the instruction command.

Revision history

Date of Point	Instruction Manual No.	Revision Details
2012-03-13	BFP-A8865	・First print

*Introduction

Thank you for purchasing the Mitsubishi industrial robot.
This instruction manual explains the method of unpacking, installation and maintenance and inspection of the robot arm.
Always read through this manual before starting use to ensure correct usage of the robot.
The information contained in this document has been written to be accurate as much as possible. Please interpret that items not described in this document "cannot be performed."

This document explains for the following robot type.

Robot type ・RH-3FH series
・RH-6FH series

・No part of this manual may be reproduced by any means or in any form, without prior consent from Mitsubishi.
・The details of this manual are subject to change without notice.
・The information contained in this document has been written to be accurate as much as possible. Please interpret that items not described in this document "cannot be performed." or "alarm may occur".
Please contact your nearest dealer if you find any doubtful, wrong or skipped point.
・This specifications is original.
Copyright(C) 2012 MITSUBISHI ELECTRIC CORPORATION

CONTENTS

Page

1 Before starting use 1-1
1.1 Using the instruction manuals 1-1
1.1.1 The details of each instruction manuals 1-1
1.1.2 Symbols used in instruction manual 1-2
1.2 Safety Precautions 1-3
1.2.1 Precautions given in the separate Safety Manual 1-4

2 Unpacking to Installation 2-6
2.1 Confirming the product 2-6
2.2 Installation 2-7
2.2.1 Unpacking 2-7
2.2.2 Transportation procedures (Transportation by people) 2-8
2.2.3 Installation procedures 2-9
2.2.4 Grounding procedures 2-11
(1) Grounding methods 2-11
(2) Grounding procedures 2-11
2.2.5 Connecting with the controller 2-12
(1) RH-3FH series 2-12
(2) RH-6FH series 2-13
2.2.6 Ethernet Cables 2-15
2.2.7 No.2 arm 2-15
2.2.8 Base area 2-16
2.2.9 About oil mist specification 2-18
(1) Piping for pressurization inside robot arm 2-18
2.2.10 About clean specification 2-18
(1) Piping for suction inside robot arm 2-18
(2) Duct installation 2-19
2.3 Setting the origin 2-20
2.3.1 Installing the teaching pendant (T/B) 2-20
2.3.2 Setting the origin with the origin data input method 2-21
(1) Confirming the origin data 2-21
(2) Turning ON the control power 2-21
(3) Preparing the T/B 2-22
(4) Selecting the origin setting method 2-23
(5) Inputting the origin data 2-24
(6) Installing the battery cover. 2-25
2.4 Confirming the operation 2-26
(1) JOINT jog operation 2-30
(2) XYZ jog operation 2-33
(3) TOOL jog operation 2-35
(4) 3-axis XYZ jog operation 2-37
(5) CYLNDER jog operation 2-39
(6) Work jog operation 2-41

3 Installing the option devices 3-47
3.1 Installing the solenoid valve set 3-47
3.2 Installing the hand input cable 3-49
3.3 Installing the hand output cable 3-50
3.4 Hand internal wiring and piping set 3-51
3.5 External Wiring and Piping Box 3-54

4 Basic operations 4-56

5 Maintenance and Inspection 5-57
5.1 Maintenance and inspection interval 5-57
5.2 Inspection items 5-58

Page
5.2.1 Daily inspection items 5-58
5.2.2 Periodic inspection 5-59
5.3 Maintenance and inspection procedures 5-60
5.3.1 Robot arm structure 5-60
5.3.2 Installing/removing the cover 5-62
5.3.3 Packing Replacement Procedure 5-64
(1) Packing Replacement Instructions 5-64
5.3.4 Inspection, maintenance and replacement of timing belt 5-68
(1) Timing belt replacement period 5-68
(2) RH-3FH series: Inspecting/Adjusting the J3 axis timing belt 5-69
(3) RH-3FH series: Replacing the J3 axis timing belt 5-70
(4) RH-6FH series: Inspecting/Adjusting the J3 axis timing belt 5-73
(5) RH-6FH series: Replacing the J3 axis timing belt 5-74
(6) RH-3FH/RH-6FH series: Inspecting/Adjusting the J4 axis timing belt 5-76
(7) Timing belt tension 5-79
5.3.5 Replacing the bellows 5-80
(1) Clean specification 5-80
(2) Oil mist specification 5-81
5.3.6 Lubrication 5-82
(1) Lubrication position and specifications 5-82
(2) Lubrication method to the J1, J2 axis 5-83
(3) Lubrication method to the shaft 5-83
5.3.7 Replacing the backup battery 5-84
(1) Replacing the battery (robot arm) 5-85
5.4 About Overhaul 5-86
5.5 Maintenance parts 5-87
5.6 Resetting the origin 5-88
5.6.1 Mechanical stopper method 5-89
(1) J1 axis origin setting(mechanical stopper) 5-89
(2) J2 axis origin setting(mechanical stopper) 5-91
(3) J3 and J4 axis origin setting (mechanical stopper) 5-93
(4) All axis origin setting 5-96
5.6.2 Jig method 5-97
(1) J1 axis origin setting 5-98
(2) J2 axis origin setting 5-100
(3) J3 and J4 axis origin setting 5-101
5.6.3 ABS origin method 5-102
(1) Select the T/B 5-103
5.6.4 User origin method 5-104
5.6.5 Recording the origin data 5-106
(1) Confirming the origin data label 5-106
(2) Confirming the origin data 5-106
(3) Recording the origin data 5-106
(4) Installing the cover 5-106
6Appendix Appendix-107
Appendix 1 : Configuration flag Appendix-107

1 Before starting use

This chapter explains the details and usage methods of the instruction manuals, the basic terminology and the safety precautions.

1.1 Using the instruction manuals

1.1.1 The details of each instruction manuals

The contents and purposes of the documents enclosed with this product are shown below. Use these documents according to the application.
For special specifications, a separate instruction manual describing the special section may be enclosed.

Safety Manual	Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot.
Standard Specifications or special Specifications	Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained.
Robot Arm Setup & Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Controller Setup, Basic Operation and Maintenance	Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures.
Detailed Explanation of Functions and Operations	Explains details on the functions and operations such as each function and operation, commands used in the program, connection with the external input/output device, and parameters, etc.
Troubleshooting	Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No.
Additional axis function	Explains the specifications, functions and operations of the additional axis control.
Tracking Function Manual	Explains the control function and specifications of conveyor tracking.

Extended Function Instruction Manual

Explains the detailed description of data configuration of shared memory, monitoring, and operating procedures, about the PLC(CR750-Q/CR751-Q controller) and the GOT(CR750-D/CR751-D controller).

1.1.2 Symbols used in instruction manual

The symbols and expressions shown in Table 1-1 are used throughout this instruction manual. Learn the meaning of these symbols before reading this instruction manual.

Table 1-1:Symbols in instruction manual

Terminology		Item/Symbol	Meaning
Item	iQ Platform (CR750-Q series)		
		Controller	Indicates the controller which controls the robot arm. It consists of the robot CPU system and the drive unit.
		The robot CPU unit or robot CPU	Indicates the CPU unit for the robots which installed to the sequencer base unit (Q3 ☐ DB) of MELSEC-Q series. It is connected with the drive unit by the dedicated cable.
		The robot CPU system	Multi-CPU system. It consists of MELSEC units, such as the sequencer base unit, the sequencer CPU unit, and the robot CPU unit, etc.
		Drive unit	Indicates the box which mounts the servo amplifier for robot, and the safety circuit, etc.
Item	Stand-alone type (CR750-D series)		
		Controller	Indicates the box which arranged control parts, such as robot CPU, servo amplifier, and the safety circuit.
Symbol		⚠ DANGER	Precaution indicating cases where there is a risk of operator fatality or serious injury if handling is mistaken. Always observe these precautions to safely use the robot.
		⚠ WARNING	Precaution indicating cases where the operator could be subject to fatalities or serious injuries if handling is mistaken. Always observe these precautions to safely use the robot.
		⚠ CAUTION	Precaution indicating cases where operator could be subject to injury or physical damage could occur if handling is mistaken. Always observe these precautions to safely use the robot.
		[JOG]	If a word is enclosed in brackets or a box in the text, this refers to a key on the teaching pendant.
		[RESET] + [EXE] (A) (B)	This indicates to press the (B) key while holding down the (A) key. In this example, the [RESET] key is pressed while holding down the [+EXE] key.
		T/B	This indicates the teaching pendant.
		O/P	Indicates the operating panel on the front of controller or drive unit for the controller which installed the operating panel

1.2 Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

⚠CAUTION All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
Enforcement of safety training

⚠CAUTION For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
Preparation of work plan

⚠WARNING Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
Setting of emergency stop switch

⚠CAUTION During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
Indication of teaching work in progress

⚠DANGER Provide a fence or enclosure during operation to prevent contact of the operator and robot.
Installation of safety fence

⚠CAUTION Establish a set signaling method to the related operators for starting work, and follow this method.
Signaling of operation start

⚠CAUTION As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
Indication of maintenance work in progress

⚠CAUTION Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
Inspection before starting work

1.2.1 Precautions given in the separate Safety Manual

The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

⚠DANGER	If the automatic operation of the robot is operated by two or more control equipment, design the right management of operation of each equipment of the customer.
⚠CAUTION	Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)
⚠CAUTION	Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.
⚠CAUTION	Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.
⚠CAUTION	Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.
⚠CAUTION	Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.
⚠CAUTION	Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.
⚠WARNING	Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.
⚠WARNING	Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.
⚠CAUTION	Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.
⚠WARNING	When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.
⚠CAUTION	Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.
⚠CAUTION	After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc. Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.
⚠CAUTION	Never carry out modifications based on personal judgments, or use non-designated maintenance parts. Failure to observe this could lead to faults or failures.
⚠ WARNING	When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

⚠CAUTION Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF.
If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.

⚠CAUTION Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters. If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters, the internal information of the robot controller may be damaged.

⚠DANGER When the SSCNETIII cable is removed, install the cap in the connector.
If the cap is not installed, there is a possibility of malfunctioning by adhesion of the dust etc.

⚠DANGER Don't remove the SSCNETIII cable, when the power supply of the robot controller is turned on. Don't face squarely the light emitted from the tip of the SSCNETIII connector or the cable. If light strikes the eyes, there is a possibility of feeling the sense of incongruity for the eyes. (The light source of SSCNETIII is equivalent to the class 1 specified to JIS C 6802 and IEC 60825-1.)

2 Unpacking to Installation

2.1 Confirming the product

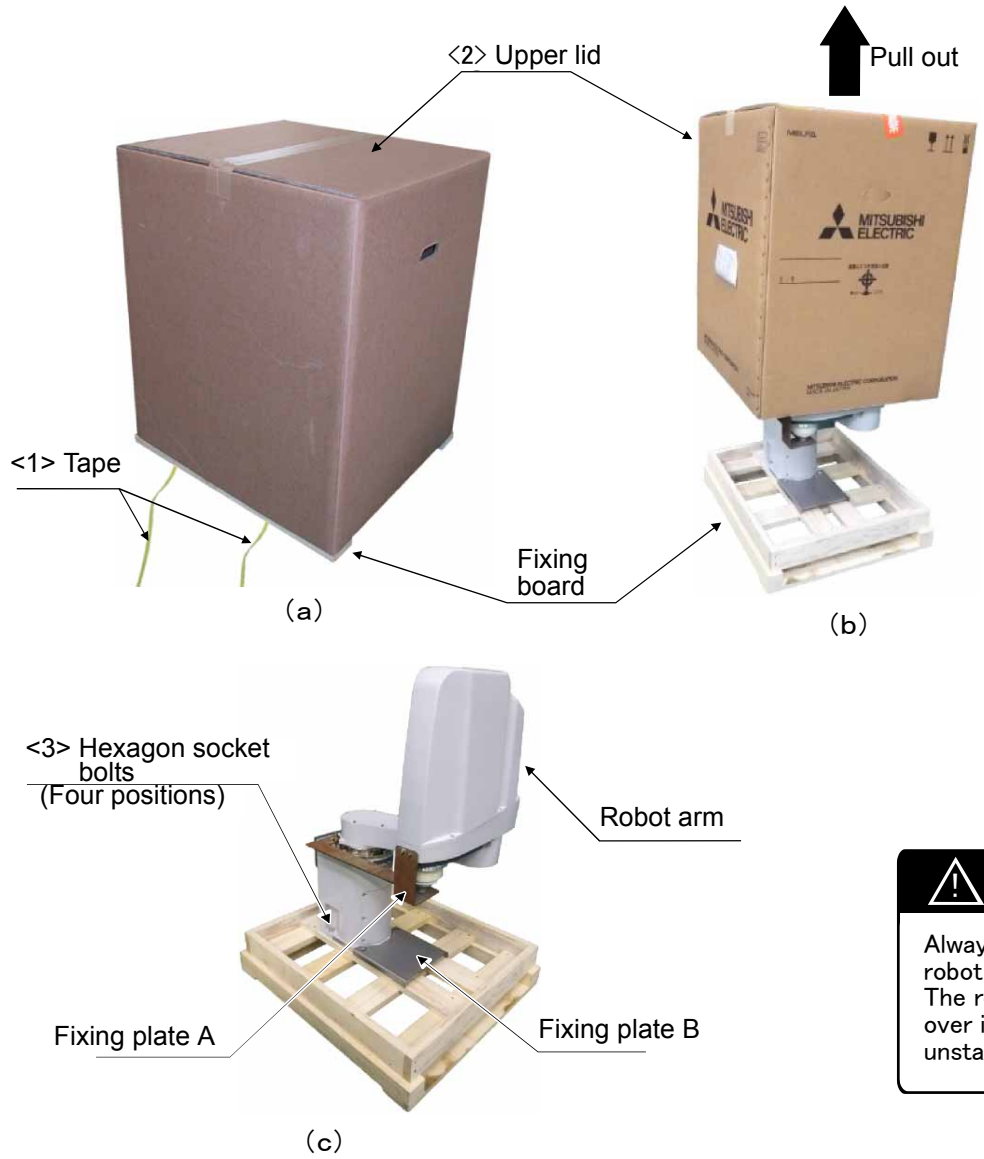
The standard configuration of the robot arm, part of the purchased product, is shown in Table 2-1.
Confirm the parts.
Users who have purchased optional products should refer to the separate "Standard Specifications".

Table 2-1 : Standard configuration

No.	Part name	Type	Qty.	Remarks
RH-3FH series				
1	Robot arm		1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M8 x 40	4 pcs.	For robot arm installation
4	Spring washer for installation bolts	For M8	4 pcs.	
5	Plain washer for installation bolts	For M8	4 pcs.	
6	Fixing plates		1 set	For robot arm transportation
7	Fixing plates installation bolt		1 set	
RH-6FH series				
1	Robot arm		1 unit	
2	Guarantee card		1 copy	
3	Installation bolts	M12 x 45	4 pcs.	For robot arm installation
4	Spring washer for installation bolts	For M12	4 pcs.	
5	Plain washer for installation bolts	For M12	4 pcs.	
6	Fixing plates		1 set	For robot arm transportation
7	Fixing plates installation bolt		1 set	

2.2 Installation

2.2.1 Unpacking



⚠CAUTION

Always unpack the robot at a flat place. The robot could tilt over if unpacked at an unstable place.

Fig.2-1 : Unpacking the robot arm

The robot is shipped from the factory in cardboard and plywood frame packing. Always refer to Fig. 2-1 and unpack the robot.

1) Using a knife, etc., slit the tape <1> fixing the upper lid <2> of the cardboard box. (Fig. 2-1 (a))
2) Pull the upper lid <2> of the cardboard box off with both hands. (Fig. 2-1 (b))
3) Remove the hexagon socket bolts <3> (four positions) which fix the robot. (Fig. 2-1 (c))

This completes the unpacking.

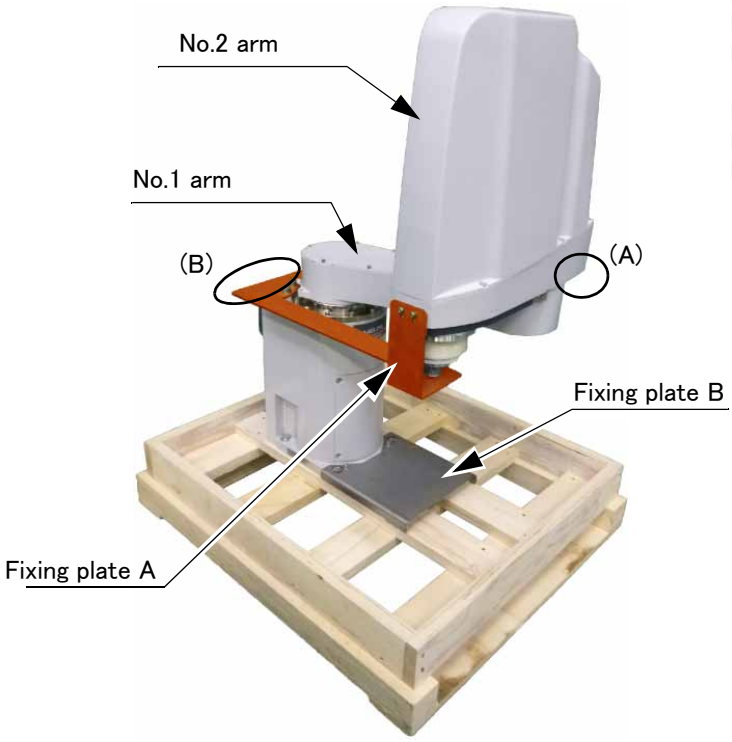
Note) The robot must be transported without removing the fixing plate A and B. Remove after installing.

⚠CAUTION When repackaging the robot in the wooden frame, always use the fixing plate.

2.2.2 Transportation procedures (Transportation by people)

Mass
RH-3FH35** series: Approx. 29kg
RH-3FH45** series: Approx. 30kg
RH-3FH55** series: Approx. 31kg

RH-6FH35** series: Approx. 39kg
RH-6FH45** series: Approx. 40kg
RH-6FH55** series: Approx. 41kg



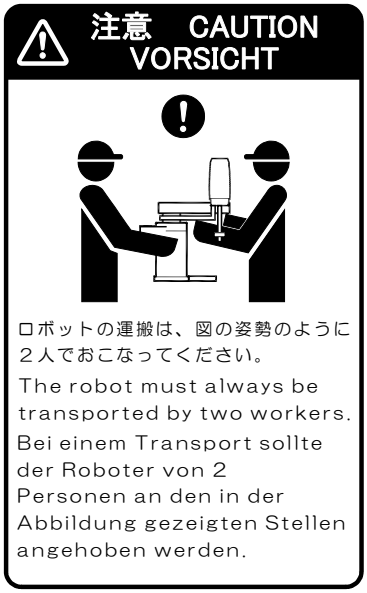


Fig.2-2 : Transportation of robot arm

1) The robot must be transported by two workers with putting the fixing plate A and B. Place the robot on a dolly, etc., and move it to near the installation place. Transporting the robot with the following grips should be limited to placing the robot on the frame or dolly, and to positioning.
2) When transporting the robot arm, one person should hold the fixing plate A and No.1 arm (A) and another person should hold the rear of the fixing plate A (illustration (B)) .
   Never hold the robot from the left/right side or the cover. It may lead to accidents such as the cover dropping off and the robot falling over, causing damage.
3) When transporting the robot, do not apply force on the cover, or apply a strong impact on the robot.
4) Remove the fixtures after installing the robot.

⚠CAUTION To prevent accidents, do not hold the robot from the left/right sides, or hold covers that have no grips .

⚠CAUTION Be careful not to apply force to the shaft section (J3 axis). The shaft may be damaged and the overload error may occur at the time of movement.

⚠CAUTION When installing the fixing tool again, place the robot in the posture where each axis shows the values listed in the table below.

Table 2-2 : Transportation posture

Axis	RH-3FH35**/RH-6FH35**	RH-3FH45**/RH-6FH45**	RH-3FH55**/RH-6FH55**
J1	49.5 deg.	25 deg.	17 deg.
J2	-139.5 deg.	-115 deg.	-107 deg.
J3	290.4mm		
J4	Not fixed		

2.2.3 Installation procedures

The installation procedure of the robot arm is shown below.

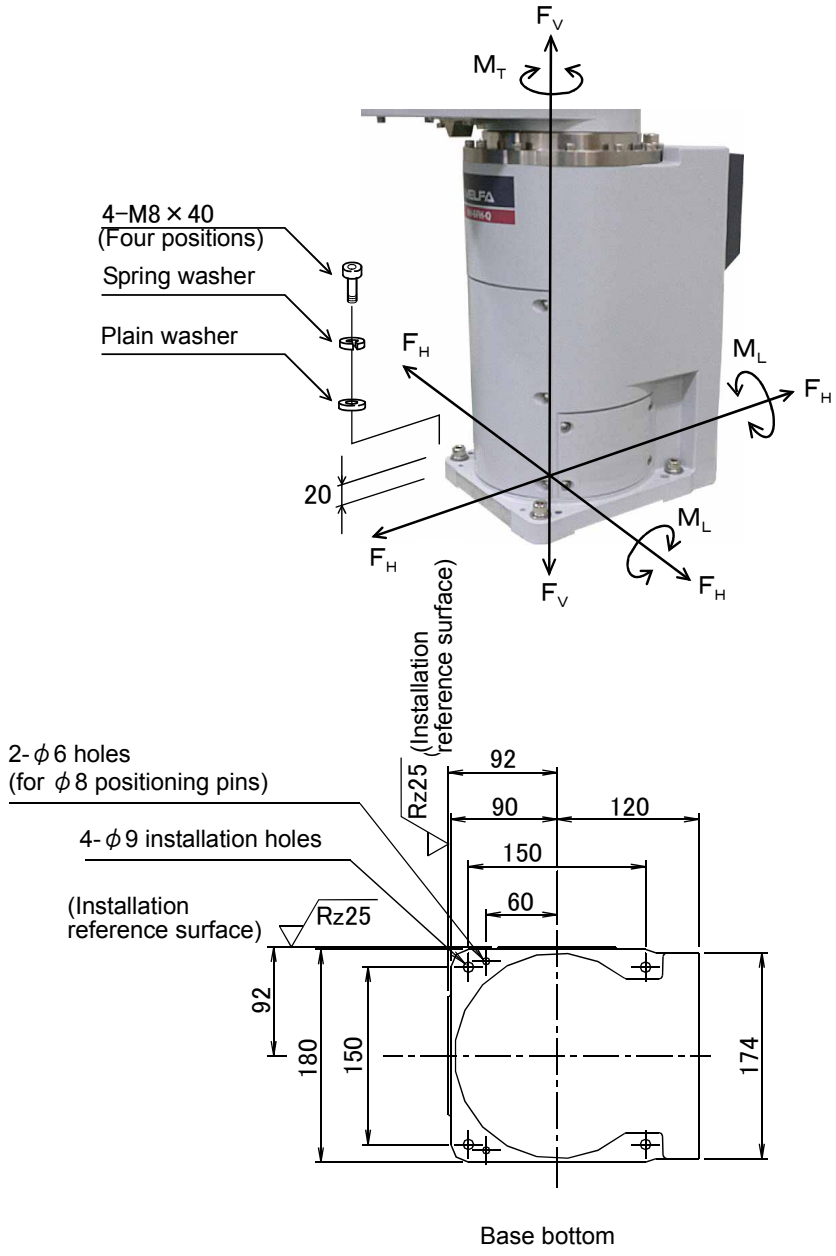


Fig.2-3 : Installation dimensions (RH-3FH/6FH)

1) The robot installation surface has been machine finished. Use the installation holes (4-φ9 holes) opened at the four corners of the base, and securely fix the robot with the enclosed installation bolts (hexagon socket bolts).
2) Install the robot on a level surface.
3) It is recommended that the surface roughness of the table onto which the robot is to be installed by Rz25 or more. If the installation surface is rough, the contact with the table will be poor, and positional deviation could occur when the robot moves.
4) When installing, use a common table to prevent the position of the devices and jigs subject to robot work from deviating.
5) The installation surface must have sufficient strength to withstand the arm reaction during operation, and resistance against deformation and vibration caused by the static (dynamic) load of the robot arm and peripheral devices, etc.
6) After installing the robot, remove the fixing plate.

7) If you operate the robot at a high speed, reaction forces are applied to the installation stand by the robot's operation. Make sure that the installation stand on which the robot is placed has sufficient strength and rigidity. Table 2-3 shows the maximum reaction force (design values) that may be applied to an installation stand. Please use these values as reference when designing the installation stand.

Table 2-3 : Magnitude of each reaction force

	Unit	Value
RH-3FH series		
Tilt moment : M_L	N・m	240
Torsional moment : M_T	N・m	255
Horizontal direction translation force : F_H	N	810
Vertical direction translation force : F_V	N	380
RH-6FH series		
Tilt moment : M_L	N・m	1,640
Torsional moment : M_T	N・m	710
Horizontal direction translation force : F_H	N	1,653
Vertical direction translation force : F_V	N	2,318

⚠CAUTION When installing the robot, secure enough space behind the robot for future maintenance to allow the connection of cables and the replacement of the backup battery.

2.2.4 Grounding procedures

(1) Grounding methods

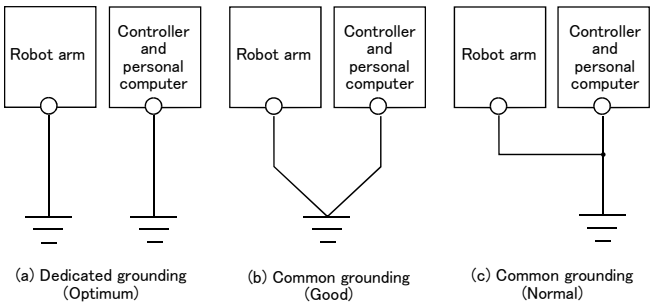


Fig.2-4 : Grounding methods

1) There are three grounding methods as shown in Fig. 2-4, but the dedicated grounding (Fig. 2-4 (a)) should be used for the robot arm and controller when possible. (Refer to the separate " Controller Setup, Basic Operation and Maintenance" for details on the controller grounding.)
2) Use Class D grounding (grounding resistance 100Ω or less).
   Dedicated grounding separated from the other devices should be used.
3) Use a AWG#11(3.5mm^2) or more stranded wire for the grounding wire. The grounding point should be as close to the robot arm and controller as possible, and the length of the grounding wire should be short.

(2) Grounding procedures

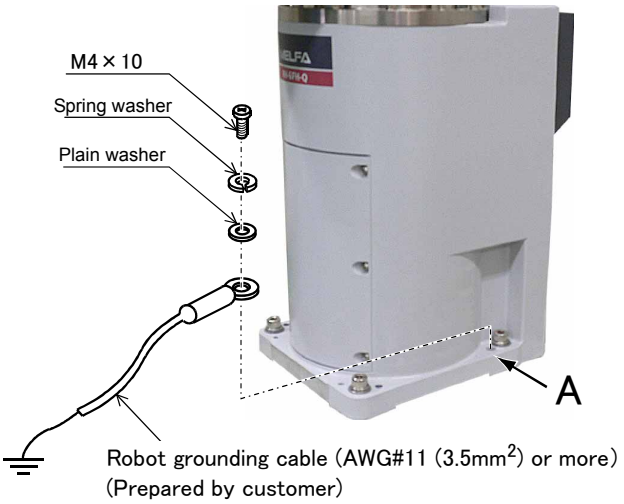


Fig.2-5 : Connecting the grounding cable

1) Prepare the grounding cable (AWG#11(3.5mm^2) or more) and robot side installation screw and washer.

2) If there is rust or paint on the grounding screw section (A), remove it with a file, etc.

3) Connect the grounding cable to the grounding screw section.

2.2.5 Connecting with the controller

(1) RH-3FH series

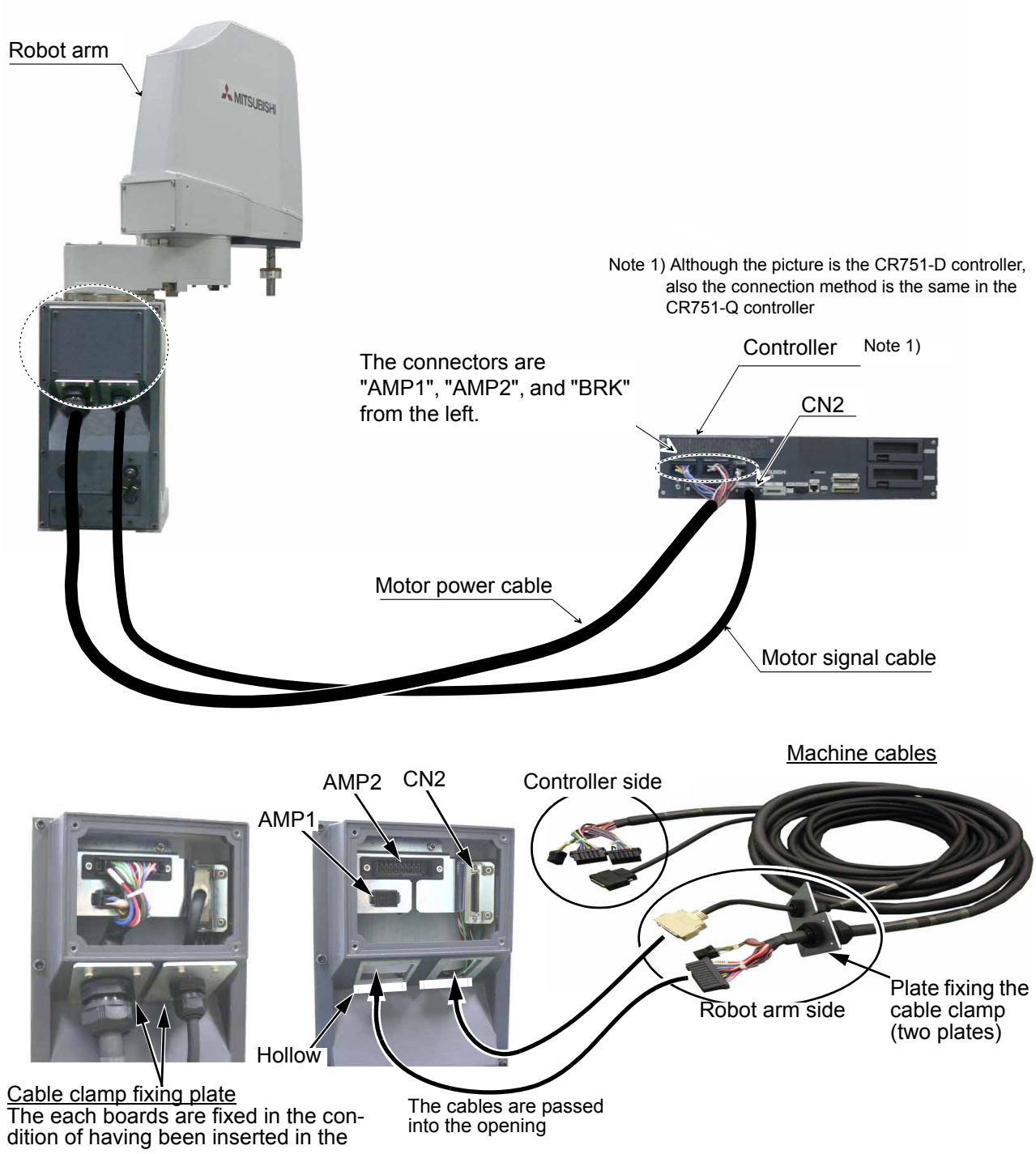

Robot arm
MITSUBISHI
Note 1) Although the picture is the CR751-D controller, also the connection method is the same in the CR751-Q controller
The connectors are "AMP1", "AMP2", and "BRK" from the left.
Controller
Note 1)
CN2
Motor power cable
Motor signal cable
Machine cables
AMP2
CN2
Controller side
AMP1
Plate fixing the cable clamp (two plates)
Robot arm side
Hollow
Cable clamp fixing plate
The each boards are fixed in the condition of having been inserted in the
The cables are passed into the opening

Fig.2-6 : Connecting the machine cables

Carry out the following procedure after installing the controller referring to the separate "Controller Setup, Basic Operation and Maintenance" manual.
The procedure of connecting the machine cable is shown below.

1) Make sure that the power switch on the front of the controller is turned OFF.
2) Connect the machine cable to its corresponding connector on the robot arm side.
   a) Refer to Page 62, "5.3.2 Installing/removing the cover", and remove the CONBOX cover.
   b) Feed the connector of robot side to the opening on the back of the robot base.

c) Insert the cable clamp fixing plate attached to the machine cable into the hollow just under the opening. Fixing the plate by two screws securely under the condition that the plates inserted into the hollow.
d) Connect the machine cable to its corresponding connector on the robot arm side. Connect the connector (AMP1, AMP2, CN2) securely.
e) Install the CONBOX cover securely as before.

This completes connecting the machine cables.

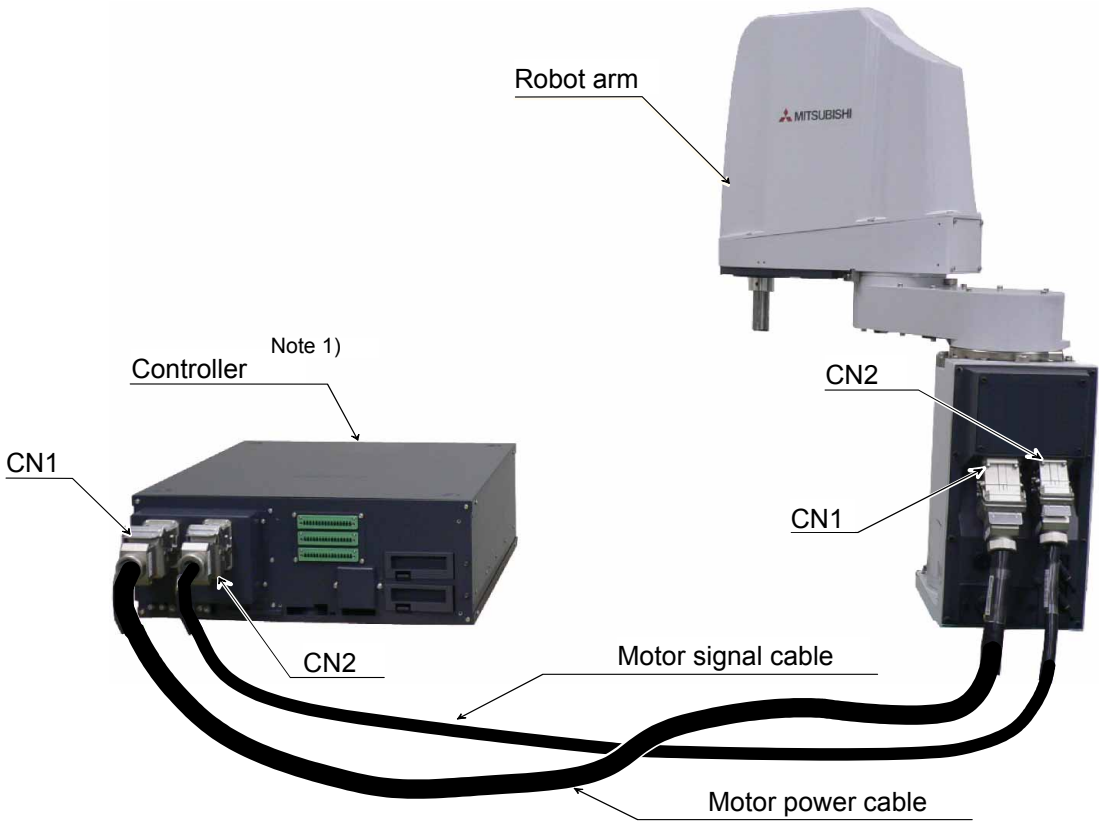
⚠ CAUTION The machine cable connectors are dedicated for the controller side and robot arm side, so take special care when connecting.
If connected incorrectly, the connector pins could bend or break. Thus, even if connected correctly, the robot will not operate correctly, creating a dangerous situation.

⚠ CAUTION Take special care to the leading of the connection cable. If the cable is pulled with force or bent excessively, wires could break or the connector could be damaged.

⚠ CAUTION Connect the machine cable at the place without the effect of the dust or oil mist. Please keep the dust and oil mist from being applied to of the robot-arm connector section, in the condition that the machine cable is removed. Since it becomes the cause of failure.

⚠ CAUTION Please be careful not to catch the hand at installation and removal.

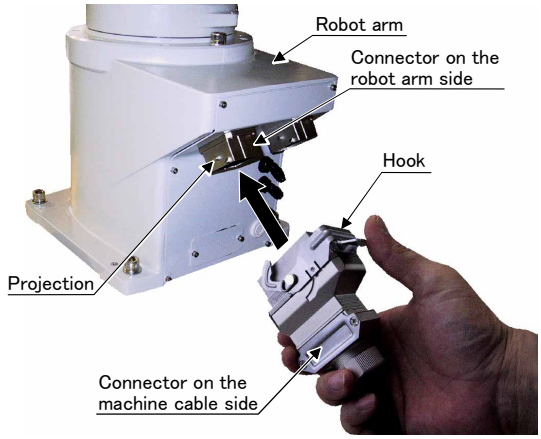
(2) RH-6FH series



Note 1) Although the picture is the CR750-D controller, also the connection method is the same in the CR750-Q controller

Fig.2-7 : Connecting the machine cables

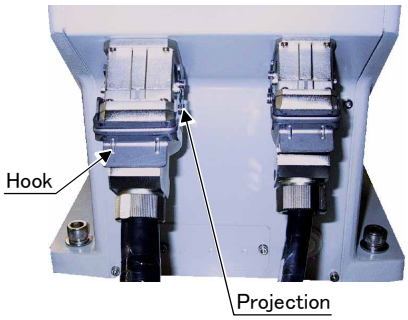
Carry out the following procedure after installing the controller referring to the separate "Controller Setup, Basic Operation and Maintenance" manual.



The procedure of connecting the machine cable is shown below. (Although the figure of the robot arm is the example of RV-12SD of our company, it is the same)

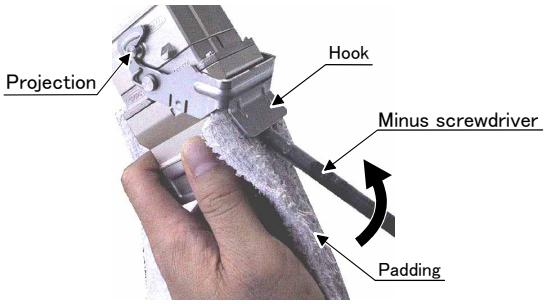
1) Make sure that the power switch on the front of the controller is turned OFF.

2) Connect the machine cable to its corresponding connector on the robot arm side.



3) After connecting the connector, insert the hook attached to the connector on the machine cable side to the rear of the projection of the robot arm connector to fix securely in place.

⚠CAUTION Be careful not to get your hand pinched.



To remove the cable, insert a minus screwdriver into the hook while padding with a cloth, and remove the cable by lifting the hook.

⚠CAUTION

When installing or removing the connector, to the connector of the other party in parallel, install or remove. If load strong against one side is applied, the connector pin may be damaged and it may not be connected securely.

⚠ CAUTION The machine cable connectors are dedicated for the controller side and robot arm side, so take special care when connecting.
If connected incorrectly, the connector pins could bend or break. Thus, even if connected correctly, the robot will not operate correctly, creating a dangerous situation.

⚠ CAUTION Take special care to the leading of the connection cable. If the cable is pulled with force or bent excessively, wires could break or the connector could be damaged.

⚠ CAUTION Connect the machine cable at the place without the effect of the dust or oil mist. Please keep the dust and oil mist from being applied to of the robot-arm connector section, in the condition that the machine cable is removed. Since it becomes the cause of failure.

⚠ CAUTION Please be careful not to catch the hand at installation and removal.

2.2.6 Ethernet Cables

Ethernet cables (4 pairs, totaling 8 lines, of AWG#24 (0.2mm2^2) cabtyre cables) are installed within the robot arm from the base unit up to the No. 2 arm, and can be used.
LAN connectors are mounted to both ends of the cables, and can therefore be used to connect to LAN connection devices. Users may also remove the LAN connectors, replace them with their own connectors, and use them as spare wiring by connecting them to user supplied cables.
Further, when passing through the inside of the shaft and using, please use the optional hand internal wiring and piping set in order to prevent the cable disconnection. (Re-cover the connector of the hand input cable that is attached to this option before using)

2.2.7 No.2 arm

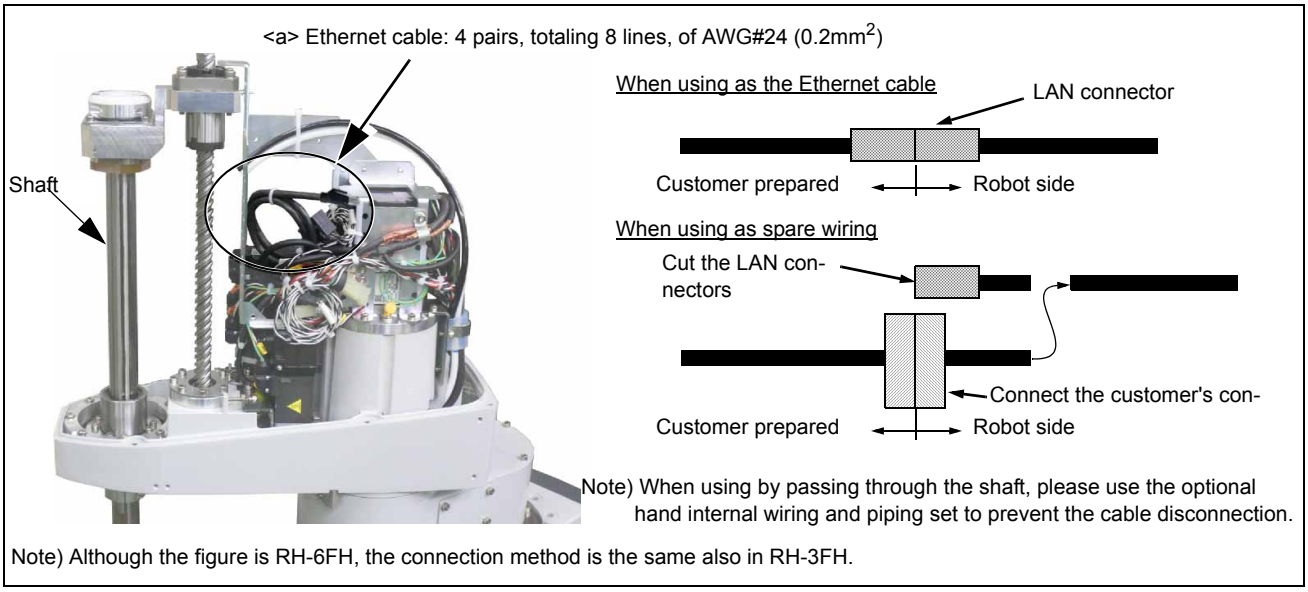

<a> Ethernet cable: 4 pairs, totaling 8 lines, of AWG#24 (0.2mm2)
Shaft
When using as the Ethernet cable
LAN connector
Customer prepared
Robot side
When using as spare wiring
Cut the LAN con-
nectors
Connect the customer's con-
Customer prepared
Robot side
Note) When using by passing through the shaft, please use the optional hand internal wiring and piping set to prevent the cable disconnection.
Note) Although the figure is RH-6FH, the connection method is the same also in RH-3FH.

Fig.2-8 : Pulling out the Ethernet cable

How to connect the Ethernet cable is shown below.

1) Remove the screws used to fix the No. 2 arm cover U, and then remove the No. 2 arm cover U.
2) Ethernet cables are located in the positions shown in Fig. 2-8 <a> (coiled and stored).
3) Remove the tying band used to coil the Ethernet cable.
4) Connect the cable on the customer supplied tool.
   (When using as spare wiring please remove the LAN connectors and replace with customer's connector)
5) It is possible to use the optional hand internal wiring and piping set to feed the tool cable through the inside of the shaft.
   Replace the connector of the hand input cable that is attached to the hand wiring and piping set, and then connect. Please reference Page 51, "3.4 Hand internal wiring and piping set".
6) After the optional hand wiring and piping set has been installed, install the No. 2 arm cover U to its original position. When installing the cover please take care not to damage the spongy sealant material.

This completed connection of the Ethernet cables on the No. 2 arm.

⚠CAUTION When installing the No. 2 arm cover U to its original position please take care not to trap any cables or air hoses. If the cables/hoses are trapped when fixing the cover then cables may be disconnected or hoses punctured, leading to the robot and air driving devices to not operate properly. The sealing property of the packing may also become seriously impaired and there is a risk that the specified level of product protection may not be achievable.

⚠CAUTION When fixing the cable, please keep too much load from being applied to the cables. If too much load is applied, the may break, when the robot moves.

⚠CAUTION When operating the robot, friction may result in dust being generated from the tip of the shaft.
On the clean specification, please be sure to seal the shaft tip with a gasket. If this is not done there is a risk that the level of cleanliness will be reduced.

2.2.8 Base area

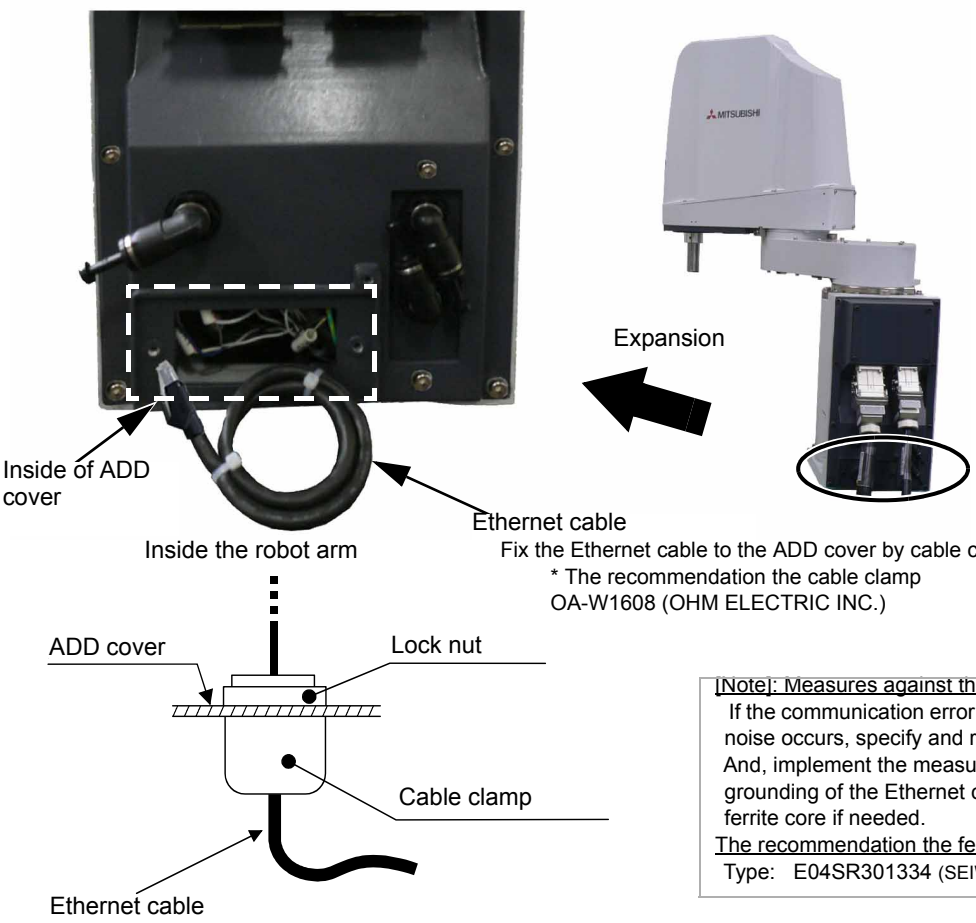

Expansion
Inside of ADD cover
Ethernet cable
Inside the robot arm
Fix the Ethernet cable to the ADD cover by cable clamp.
* The recommendation the cable clamp
OA-W1608 (OHM ELECTRIC INC.)
ADD cover
Lock nut
Cable clamp
Ethernet cable
[Note]: Measures against the noise
If the communication error considered to originate by the noise occurs, specify and remove the noise source. And, implement the measures against the noise by grounding of the Ethernet cable, and the addition of the ferrite core if needed.
The recommendation the ferrite core
Type: E04SR301334 (SEIWA ELECTRIC MFG. CO., LTD.)

Fig.2-9 : Pull out the Ethernet cable (Base side)

1) Loosen the two screws and remove the ADD cover located at the back of the robot base.
2) Pull out the Ethernet cable that is stored inside the cover (coiled and stored).
3) Remove the cable tie of Ethernet cable.
4) Remove the lock nut attached to the cable clamp (customer prepared) and pass through the Ethernet cable
5) Remove the grommet of ADD cover. After removing the grommet please remove the sealant material that remains in the hole in the plate.
6) Feed the Ethernet cable through the hole that was created by removing the grommet.
7) Feed the end of the Ethernet cable through the cable clamp and securely fasten the ADD cover with the lock nut.
8) Install the ADD cover in its original position. When installing the cover please take care not to damage the spongy sealing material stuck to the hole.

This completed pull out the Ethernet cables of the base section.

⚠CAUTION Take care against applying big force to the Ethernet cable, other cables, and the air hose.

⚠CAUTION

Please confirm not having broken or not having stripped the packing when installing or removing the cover. Contact to the dealer if packing is broken or has stripped. Failure will be caused if the robot is used under the condition that the packing is broken or stripped, because oil mist etc. will invade in the arm.

⚠CAUTION

When ADD cover is installed, please keep too much load from being applied to the cables and the air hoses. If too much load is applied, the cable will be broken and the hose is bent, therefore robot and pneumatic drive equipment cannot operate normally.

⚠CAUTION

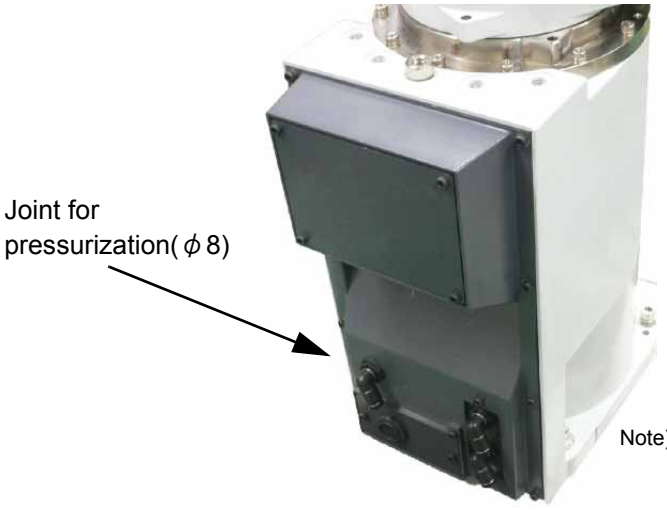
When ADD cover is installed, catch neither the cable nor the air hose.
If the bolt is tightened while it had been caught, the cable will be broken and the hose is bent, and the robot and pneumatic drive equipment cannot operate normally. Moreover, packing does not stick securely and protection specification cannot be secured.

2.2.9 About oil mist specification

(1) Piping for pressurization inside robot arm

In use in oil mist environment, protection performance can be improved by pressurizing the inside of the robot arm. Please connect the phi8 air hose to the joint for pressurization of the robot arm base portion "AIR PURGE", and pressurize the inside of the robot arm.

Refer to the separate "Standard specifications manual" for specification of air purge.



Note) Although the figure is RH-6FH, the position of the joint is the same also in RH-3FH.

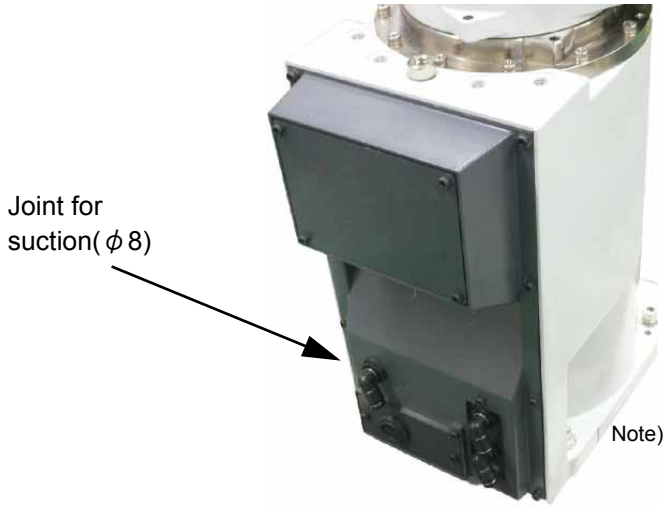
Fig.2-10 : Air purge

2.2.10 About clean specification

(1) Piping for suction inside robot arm

In use of the robot of clean specification, please connect the phi8 air hose to the joint for suction of the robot body base portion "VACUUM", and suck the inside of the robot body.

Refer to the separate "Standard specifications manual" for vacuum condition.



Note) Although the figure is RH-6FH, the position of the joint is the same also in RH-3FH.

Fig.2-11 : Vacuum

(2) Duct installation

Remove the CONBOX cover on the robot arm rear and install the attached ventilation duct (referenceFig. 2-12). As the Z axis moves up and down the volume of the bellows varies, and air is sucked in and released out of the robot's ventilation duct opening. Be sure to locate the ventilation duct's opening in a position that will not affect the robot's cleanliness.

Furthermore, whilst it is only a small amount, internal suction results in external air flowing into the robot through the ventilation duct's opening, and therefore the following two points should be considered when deciding where to locate the ventilation duct's opening.

- The opening should be facing downwards
- The opening should not be located in the vicinity of dust/dirt or liquids, etc.
  (Recommended cleanliness of surrounding area: less than ISO class 5)

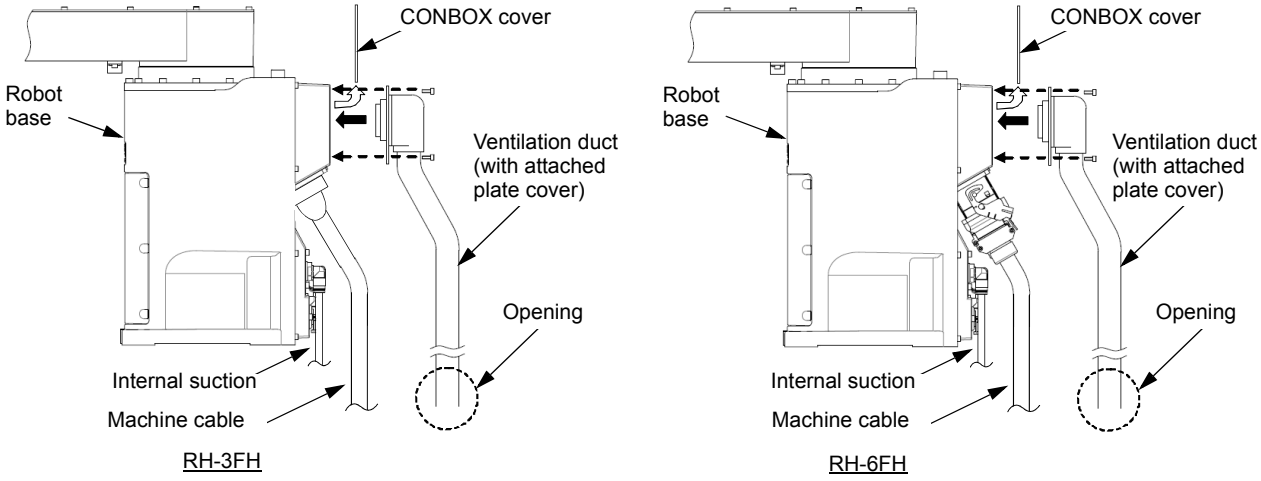


Fig.2-12 : Installation of Exhaust Duct

Note) When using the optional electromagnetic valve set, we recommend using the primary piping's spare piping (φ6 air hose) to release the exhaust fumes.
Please take care as leaking exhaust fumes inside the robot may have an impact on the robot's cleanliness.

2.3 Setting the origin

The origin is set so that the robot can be used with a high accuracy. After purchasing the robot, always carry out this step before starting work. This step must also be carried out if the combination of robot and controller being used is changed.

There are several methods for setting the origin, but the origin data input method will be explained here. Refer to Page 88, "5.6 Resetting the origin" for the other methods.

The teaching pendant is required for this operation.

[Caution] If the origin data at shipment is erased due to out of battery, it is necessary to set the origin again. Refer to Page 88, "5.6 Resetting the origin" and reset the origin using the jig method or ABS method.

2.3.1 Installing the teaching pendant (T/B)

When installing and removing the T/B, turn off the controller power supply. If T/B is installed or removed in the state of power supply ON, emergency stop alarm will occur.

If you use the robot wherein T/B is removed, please install the attached dummy connector. With the connector, put the dummy connector or draw it out.

⚠ CAUTION

Please do not pull the cable of T/B strongly or do not bend it too much.
It becomes the breaking of a wire of the cable and the cause of breakage of the connector. Please installing and removing so that stress does not start the cable with the connector itself.

Explain the installation method of T/B below.

1) Check that the POWER (power supply) switch of the robot controller is OFF.
2) Connects T/B connector to the robot controller. Use as the upper surface the lock lever shown in Fig. 2-13, and push in until there is sound.

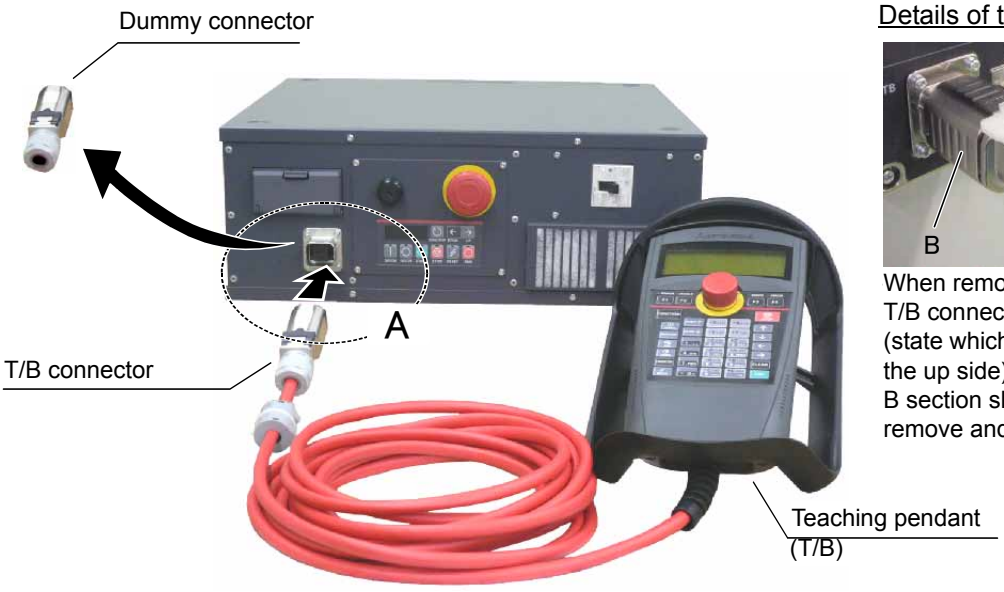

Dummy connector
A
T/B connector
Teaching pendant
(T/B)
Details of the A section
Lock lever
B
When removing the connector for T/B connection, use lock release (state which raised the lock lever to the up side), make the case of the B section slide to the front, and remove and pull up out the latch.

Fig.2-13 : Installing and removing the T/B

The installation of T/B is finished.

◇◆◇ If error C0150 occurs ◇◆◇

At the time of the first power supply injection, error:C0150 (the serial number of the robot arm has not been set up) occur the robot after purchase.

Parameter: Please input the serial number of the robot body into RBSERIAL. Refer to "instructions manual / controller setup, and basic operation & maintenance" for the operation method.

2.3.2 Setting the origin with the origin data input method

(1) Confirming the origin data

● Origin data history table (Origin Data History) Serial No.ES804008

Date	Default	. . .	. . .	. . .
D	V!#S29			
J 1	06DTYY			
J 2	2?HL9X			
J 3	1CP55V			
J 4	T6!M$Y			
J 5	Z2IJ%Z			
J 6	A12%Z0			
Method	E	E・N・SP	E・N・SP	E・N・SP

(O: O(Alphabet), 0: Zero)

Note) Meanings of symbols in method column
E: Jig method
N: Not used
SP: Not used

The origin data to be input is noted in the origin data sheet enclosed with the arm, or on the origin data history table attached to the back side of the battery cover. (Refer to Fig. 2-14).

Referring to Page 62, "5.3.2 Installing/ removing the cover", remove the battery cover and confirm the value.

The value given in the default setting column is the origin settings set with the calibration jig before shipment.

Fig.2-14 : Origin data label (an example)

* The origin data to input is found on also the robot examination report sheet.

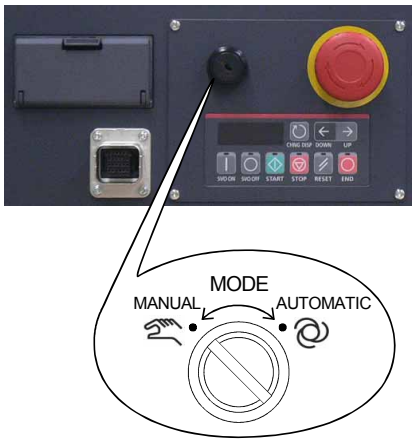
⚠ WARNING Always install/remove the cover with the controller control power turned OFF. Failure to do so could lead to physical damage or personal injury should the robot start moving due to incorrect operations.

(2) Turning ON the control power

⚠ CAUTION Confirm that there are no operators near the robot before turning the power ON.

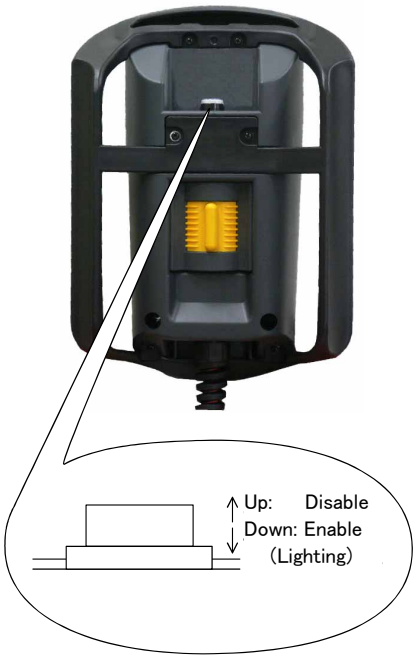
1) Turn the controller [POWER] switch ON.
The CR750-D controller turns ON the front power switch.
The CR751-D controller turns ON the switch of the earth leakage breaker of installation outside.

(3) Preparing the T/B



Next, prepare to use the T/B

1) Set the MODE of the controller to "MANUAL".

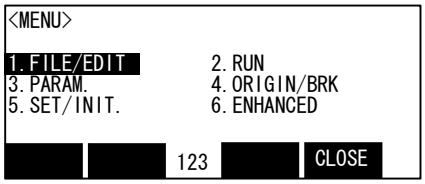


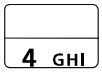
2) Set the T/B [ENABLE] switch to "ENABLE". The menu selection screen will appear.
The following operations are carried out with the T/B.

◇◆◇ Operating from the T/B ◇◆◇

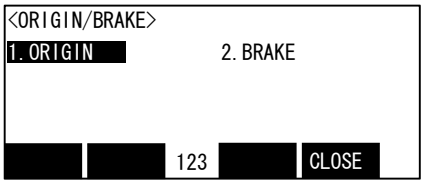
Always set the mode of the controller to "MAMNUAL", and then set the T/B [ENABLE] switch to "ENABLE". When the T/B is valid, only operations from the T/B are possible. Operations from the controller or external signals will not be accepted.

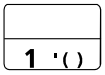
(4) Selecting the origin setting method



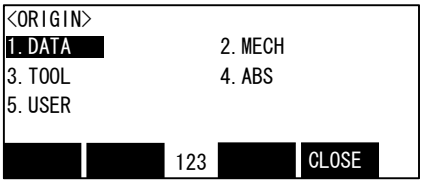


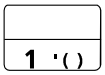
1) Press the [4] key on the menu screen, and display the ORIGIN/BRAKE screen.





2) Press the [1] key on the ORIGIN/BRAKE screen, and display the origin setting method selection screen.





3) Press the [1] key on the origin setting method selection screen, and select the data input method.

4) Display the origin data input screen

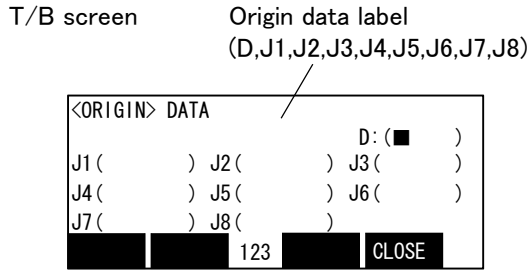
◇◆◇ Selecting a menu ◇◆◇

The menu can be selected with one of the following methods.
A: Press the numeral key for the No. of the item to be selected.
B: Using the [↓] and [↑] keys, etc., move the cursor to the item to be selected, and then press the [INP] key.

◇◆◇ The input method of numeral ◇◆◇

The number can be inputted if the key displayed on the lower left of each key is pressed. Press the [CHARACTER] key, and in the condition that "123" is displayed on the screen lower side, press the number key.

(5) Inputting the origin data

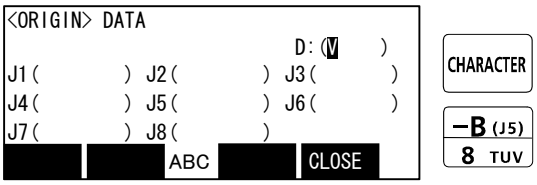


Input the value confirmed in section Page 21, "(1) Confirming the origin data".
The correspondence of the origin data label value and axis to be input is shown in Fig. 2-15.

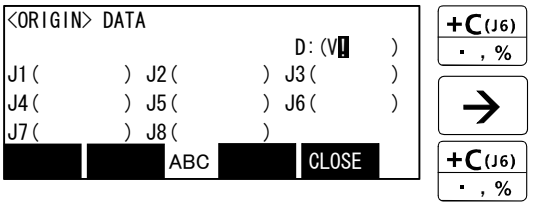
Fig.2-15 : Correspondence of origin data label and axis

The method for inputting the origin data is explained below. The value shown in Fig. 2-14 will be input as an example.

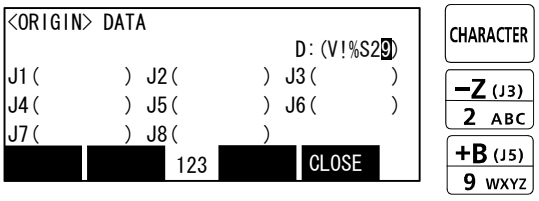
1) Confirm that the cursor is at the "D" position on the T/B display screen.



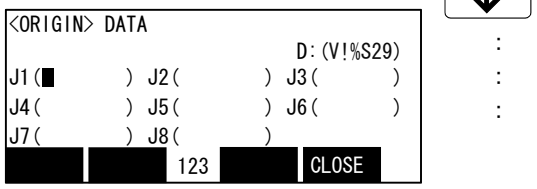
2) Input the D value "V!%S29".
Inputting "V"
Press the [CHARACTER] key and set to the character input mode. (Condition that "ABC" was displayed under the screen)
Press the [TUV] key three times. "V" will be set.



Inputting "!"
Press the [, %] key five times. "!" will be set.
Press the [→] key once and advance the cursor.
Press the [, %] key twice (input "%"), and press the [PQRS] key four times (input "S").

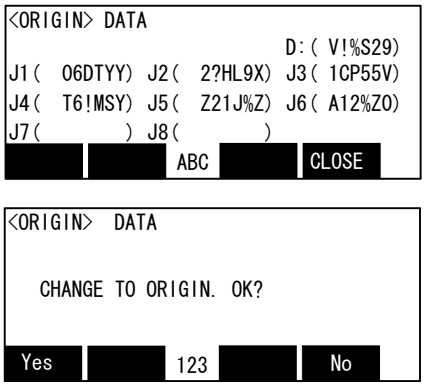


Press the [CHARACTER] key and set to the numeral input mode. (Condition that "123" was displayed under the screen)
Press the [2] key (input "2"), and press the [9] key (input "9").
"V!%S29" will appear at the "D" data on the teaching pendant screen.



3) Press the [↓] key, and move the cursor to the J1 input position.
4) Input the J1 value in the same manner as above.

Input the J2, J3, J4, J5 and J6 values in the same manner.



EXE

F1

5) After inputting all of the values, press the [EXE] key. The origin setting confirmation screen will appear.

6) Press [F1] (Yes) to end the origin setting

◇◆◇ Moving the cursor ◇◆◇
Press the [↑], [↓], [←] and [→] keys.

◇◆◇ Inputting characters ◇◆◇
Press the [CHARACTER] key and set to the character input mode. (Condition that "ABC" was displayed under the screen). The displayed character is scrolled each time at pressing the key.

◇◆◇ Correcting an input ◇◆◇
After returning one character by pressing the [C L E A R] key, input the character again.

(6) Installing the battery cover.
Return the battery cover removed in section Page 21, "(1) Confirming the origin data" to its original position.
This completes the setting of the origin with the origin data input method.

⚠ WARNING

Always remove and install the cover with the controller power turned OFF. Failure to do so could lead to the robot moving because of incorrect operations, or to physical damage or personal injury.

◇◆◇ If the origin input data is incorrect ◇◆◇
If the origin input data is incorrect, the alarm No. 1760 (origin setting data illegal) will occur when origin data input. In this case, reconfirm the value input for the origin data.

2.4 Confirming the operation

In this section, the robot will be moved manually using the T/B to confirm that the operation is correct.
Moving the robot manually is called "jog operation". This operation includes the JOINT jog that moves each axis, the XYZ jog that moves along the base coordinate system, the TOOL jog that moves along the tool coordinate system, and the CYLNDER jog that moves along the circular arc.
This operation is carried out while pressing the deadman switch on the back of the T/B.

⚠ CAUTION

The robot will move during this operation. Make sure that there are no operators near the robot, and that there are no obstacles, such as tools, in the robot operation range.

⚠ CAUTION

To immediately stop the robot, release the deadman switch on the back of the T/B. The servo power will turn OFF, and the robot will stop.
The robot will also stop if the [EMG.STOP] switch (emergency stop switch) on the front of the T/B or the [EMG.STOP] switch (emergency stop) on the front of the controller is pressed.

⚠ WARNING

Confirm that the origin has been set. If the origin has not been set, "****" will appear at the current position display on the teaching pendant, the JOINT jog operation will take place in any jog mode selected.
Refer to "2.3Setting the origin" on page 20 for details on setting the origin.

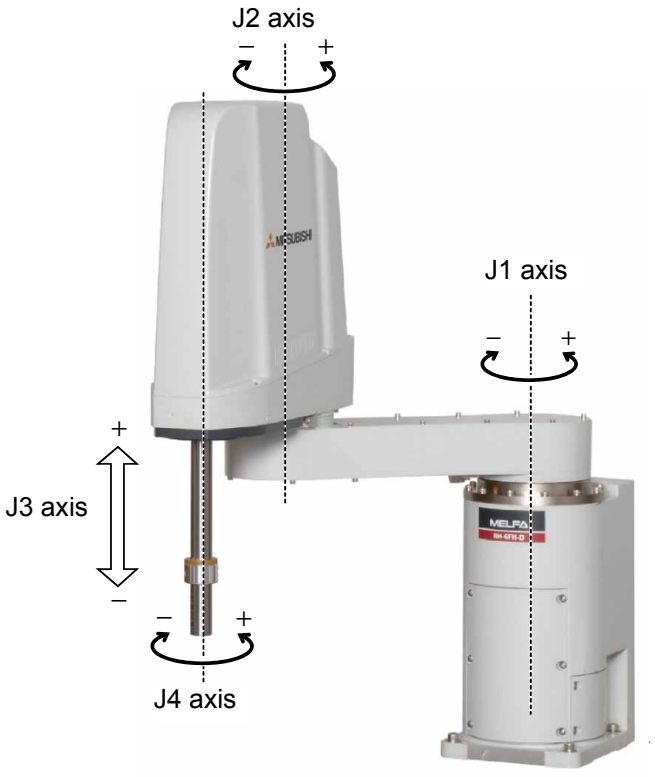
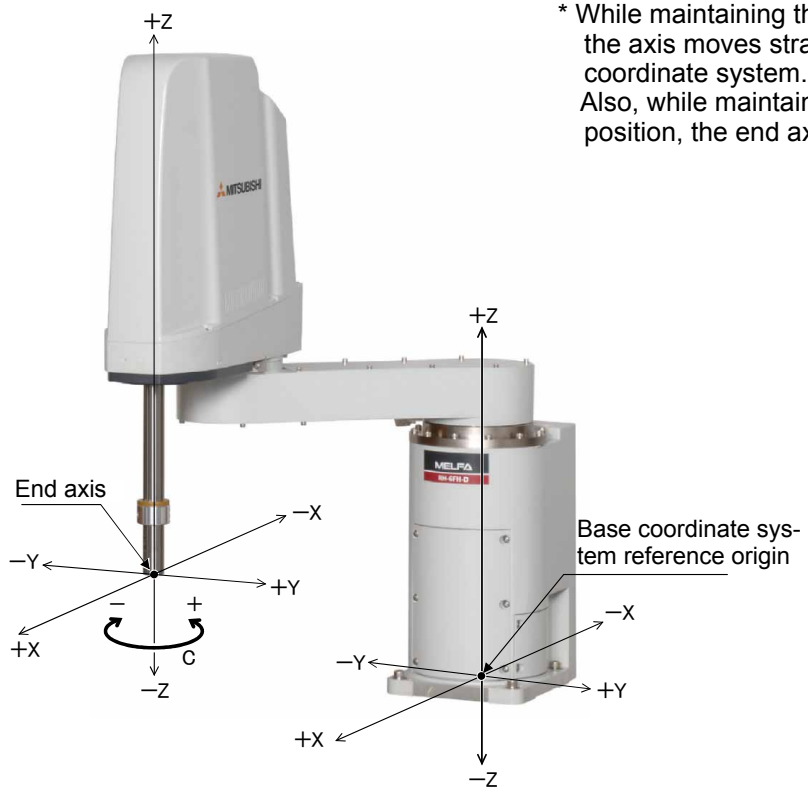
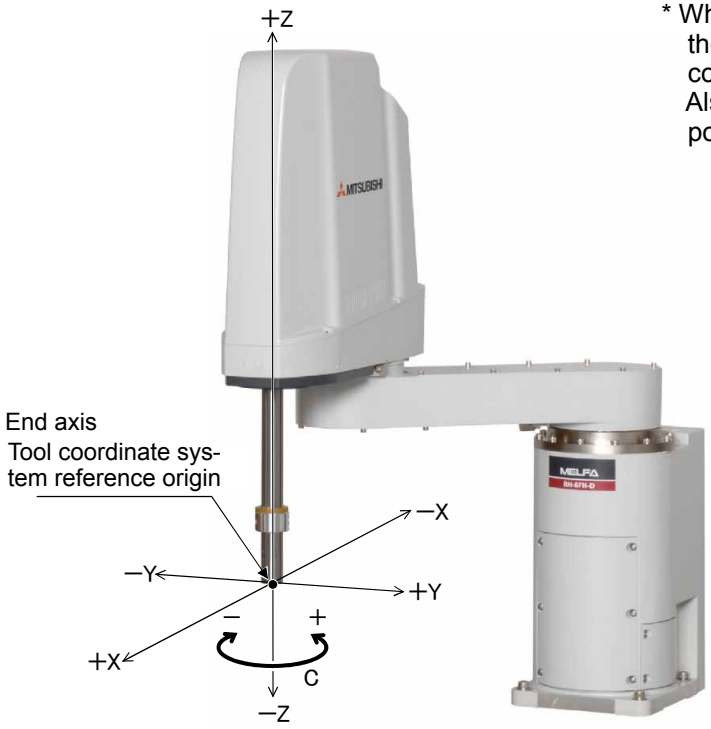


Fig.2-16 : JOINT jog operation



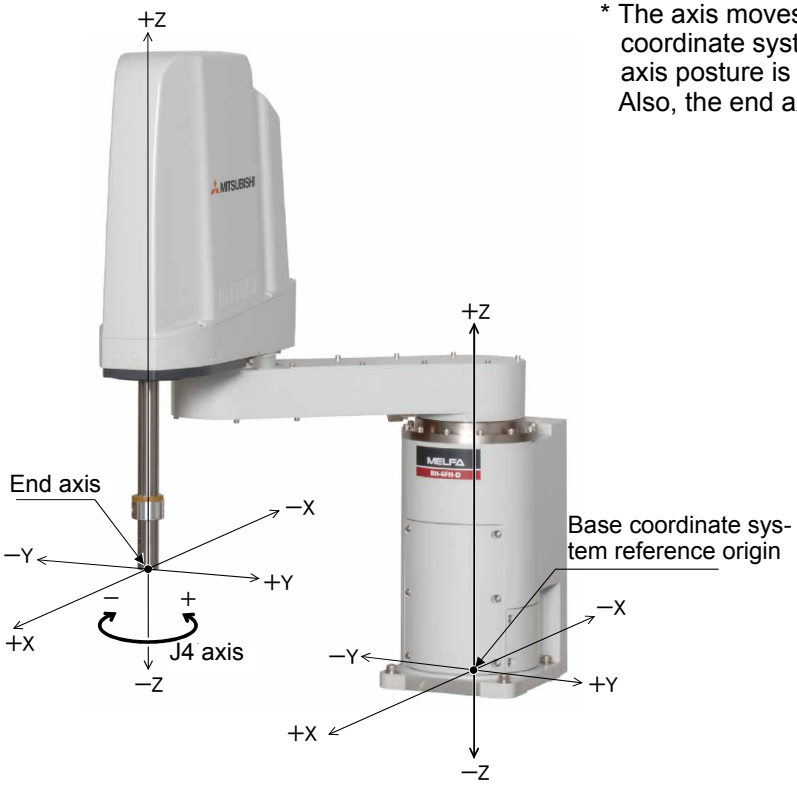
* While maintaining the end axis posture, the axis moves straight along the base coordinate system.
Also, while maintaining the end axis position, the end axis posture changes..

Fig.2−17 : XYZ jog operation



* While maintaining the end axis posture, the axis moves straight along the tool coordinate system.
Also, while maintaining the end axis position, the end axis posture changes

Fig.2−18 : TOOL jog operation



* The axis moves straight along the base coordinate system. At this time, the end axis posture is not maintained. Also, the end axis posture changes.

Fig.2-19 : 3-axis XYZ jog operation

* The current position is set as the arc centering on the Z axis, and the axis moves along that arc, expands and contracts in the radius direction, and moves vertically. At this time, the end axis posture is maintained. Also, while maintaining the axis posture position, the end axis posture changes.

Fig.2-20 : CYLINDER jog operation

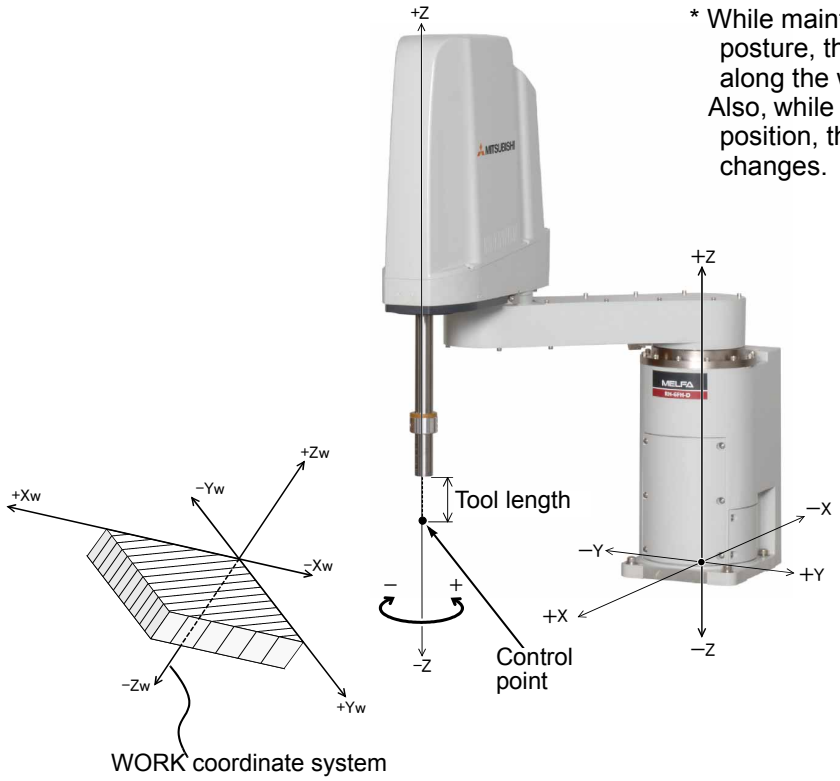
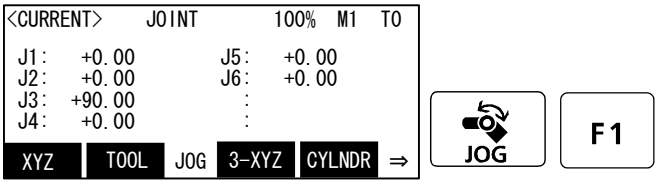


Fig.2-21 : WORK jog operation

(1) JOINT jog operation

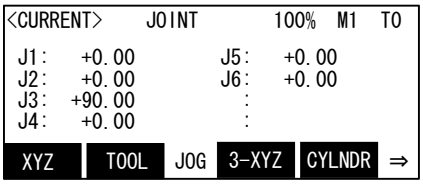
Select joint jog mode



Joint jog mode

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "joint" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "joint." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

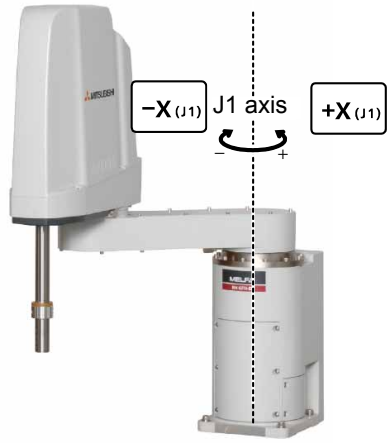
Set jog speed



Setting the speed

Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

J1 axis jog operation



・ When the [+X (J1)] keys are pressed, the J1 axis will rotate in the plus direction.
When the [−X (J1)] keys are pressed, Rotate in the minus direction.

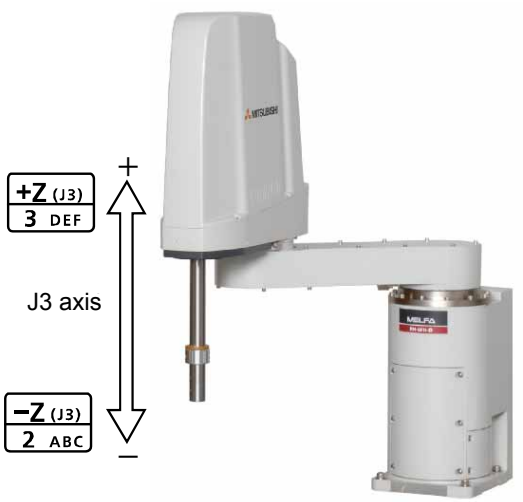
J2 axis jog operation

・When the [+Y (J2)] keys are pressed, the J2 axis will rotate in the plus direction.
When the [−Y (J2)] keys are pressed, Rotate in the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇

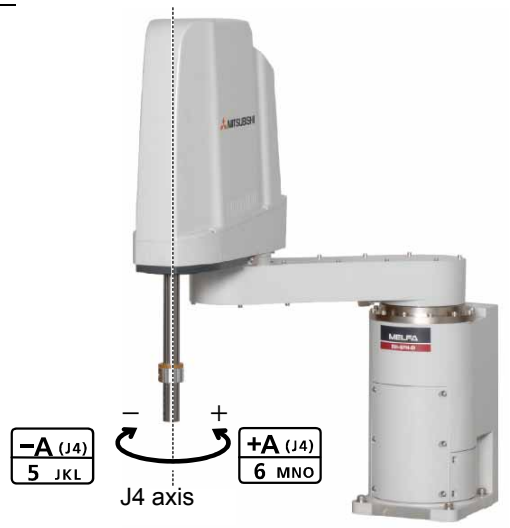
The axes may be outside the movement area. Move these axes toward the inner side of the movement area.

J3 axis jog operation



・When the [+Z (J3)] keys are pressed, the J3 axis will rotate in the plus direction.
When the [−Z (J3)] keys are pressed, Rotate in the minus direction.

J4 axis jog operation



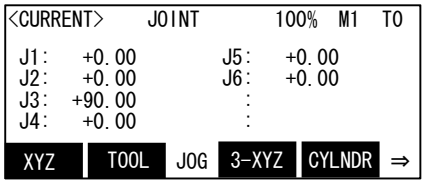
・When the [+A (J4)] keys are pressed, the J4 axis will rotate in the plus direction.
When the [−A (J4)] keys are pressed, Rotate in the minus direction.

◇◆◇If the buzzer of T/B sounds and the robot does not move ◇◆◇

If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

(2) XYZ jog operation

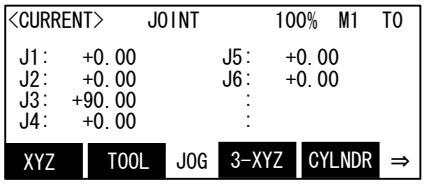
Select XYZ jog mode



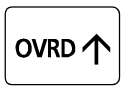
XYZ jog mode

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "XYZ" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "XYZ." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Set jog speed

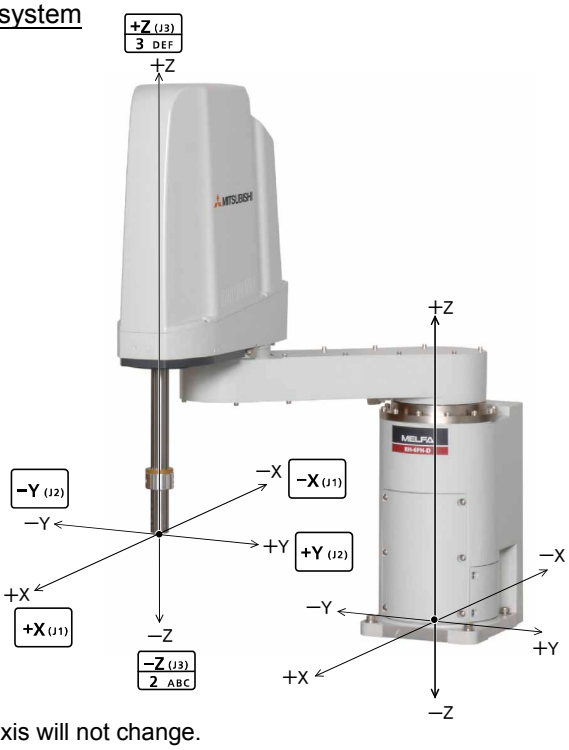


Setting the speed



Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

Moving along the base coordinate system



*The direction of the end axis will not change.

- When the [+X (J1)] keys are pressed, the robot will move along the X axis plus direction. When the [−X (J1)] keys are pressed, Move along the minus direction.
- When the [+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction. When the [−Y (J2)] keys are pressed, Move along the minus direction.
- When the [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction. When the [−Z (J3)] keys are pressed, Move along the minus direction.

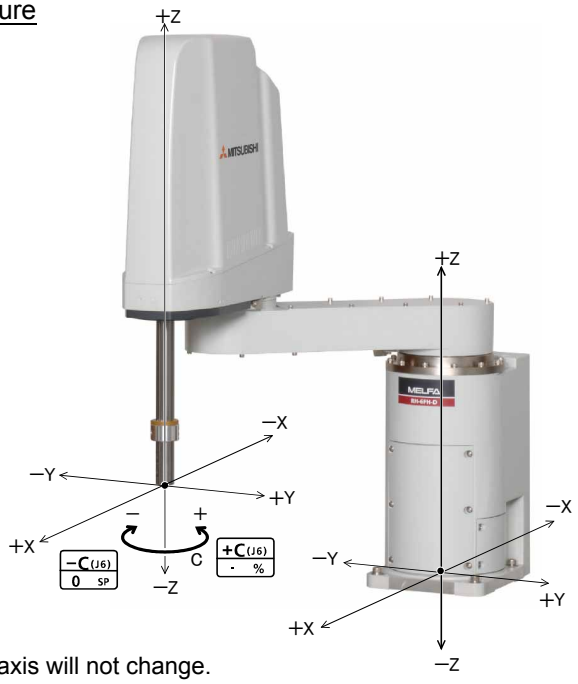
◇◆◇ When the robot is in the transportation posture ◇◆◇

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section "(1)JOINT jog operation" on page 30, and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

◇◆◇If the buzzer of T/B sounds and the robot does not move ◇◆◇

If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

Changing the end axis posture



*The position of the end axis will not change.

・When the [+C (J6)] keys are pressed, The Z axis will rotate in the plus direction.
When the [−C (J6)] keys are pressed, Rotate in the minus direction.

◇◆◇ When alarm No. 5150 occurs ◇◆◇

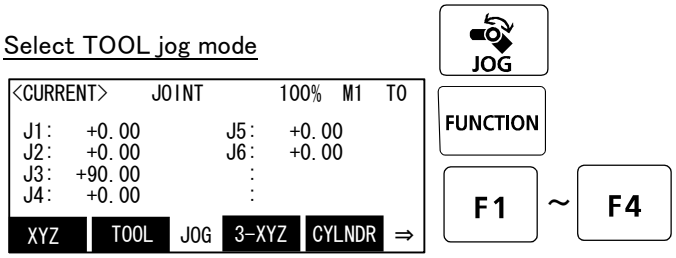
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ Tool length ◇◆◇

The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(3) TOOL jog operation

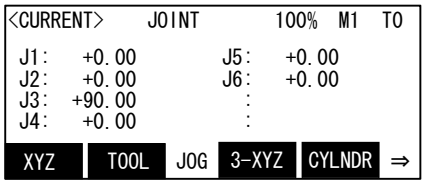
Select TOOL jog mode



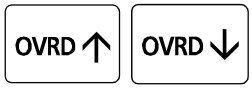
TOOL jog mode

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "TOOL" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "TOOL." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Set jog speed

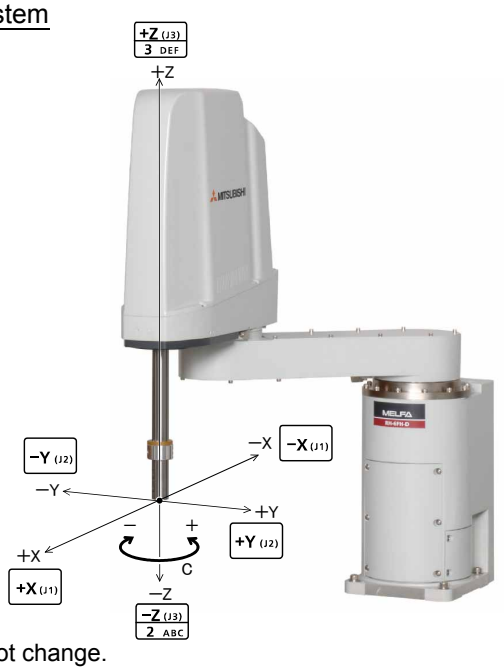


Setting the speed



Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

Moving along the tool coordinate system



*The direction of the end axis will not change.

・When the [+X (J1)] keys are pressed, the robot will move along the X axis plus direction of the tool coordinate system.
When the [−X (J1)] keys are pressed, Move along the minus direction.
・When the [+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction of the tool coordinate system.
When the [−Y (J2)] keys are pressed, Move along the minus direction.
・When the [+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction of the tool coordinate system.
When the [−Z (J3)] keys are pressed, Move along the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section "(1)JOINT jog operation" on page 30, and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

◇◆◇If the buzzer of T/B sounds and the robot does not move ◇◆◇

If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

Changing the end axis posture

*The Position of the end axis will not change.

・When the[+C (J6)] keys are pressed, The Z axis will rotate in the plus direction of the tool coordinate system. When the[−C (J6)] keys are pressed, Rotate in the minus direction.

◇◆◇ When alarm No. 5150 occurs ◇◆◇

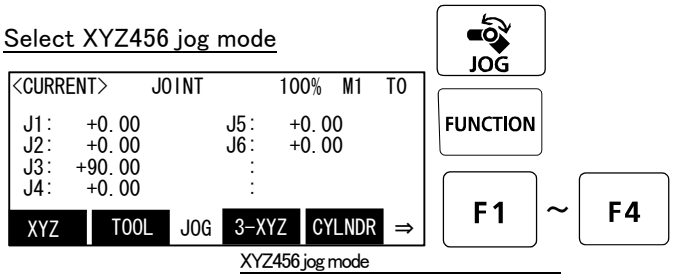
If alarm No. 5150 (ORIGIN NOT SET) occurs, the origin has not been set correctly. Reconfirm the value input for the origin data.

◇◆◇ Tool length ◇◆◇

The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

(4) 3-axis XYZ jog operation

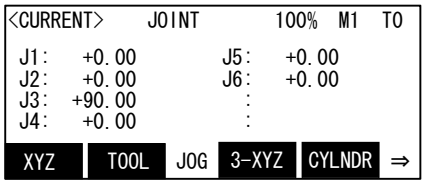
Select XYZ456 jog mode



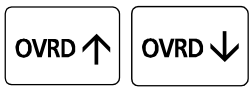
XYZ456 jog mode

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "XYZ456" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "XYZ456." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Set jog speed

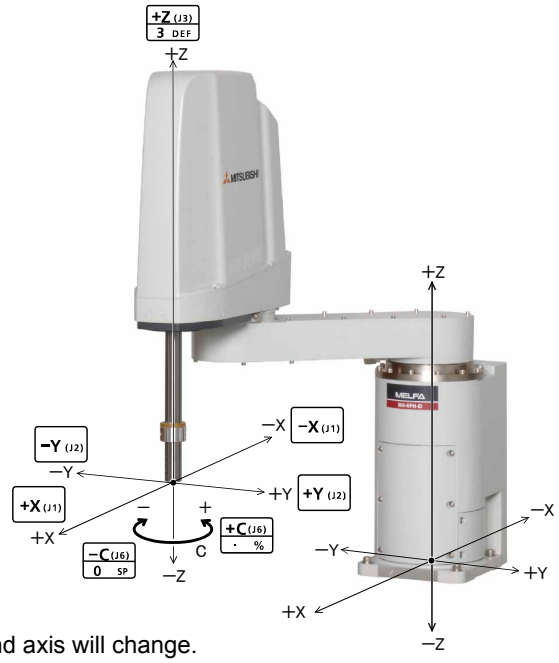


Setting the speed



Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

Moving along the base coordinate system



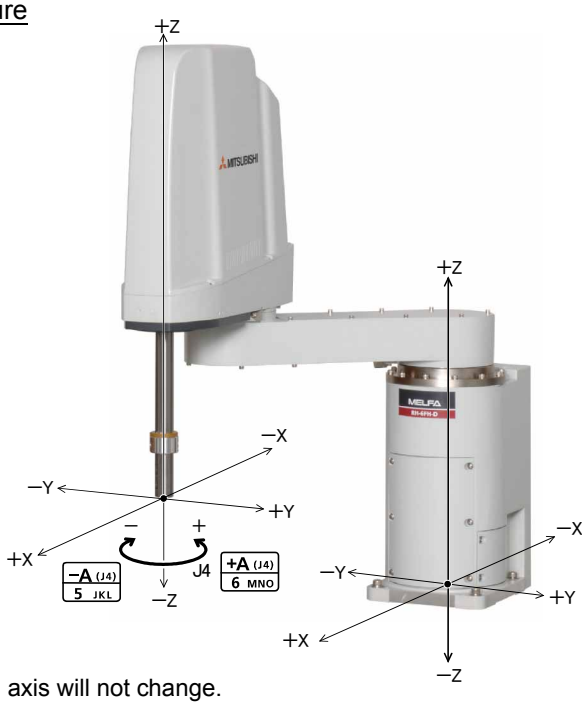
*The direction of the end axis will change.

- When the[+X (J1)] keys are pressed, the robot will move along the X axis plus direction.
  When the[−X (J1)] keys are pressed, Move along the minus direction.
- When the[+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction.
  When the[−Y (J2)] keys are pressed, Move along the minus direction.
- When the[+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
  When the[−Z (J3)] keys are pressed, Move along the minus direction.

◇◆◇ The flange surface end axis posture cannot be maintained with 3-axis XYZ jog. ◇◆◇

With 3-axis XYZ jog, the flange surface end axis posture (orientation) is not maintained when moving linearly in the X, Y or Z axis direction.
Use XYZ jog to maintain the posture.

Changing the end axis posture

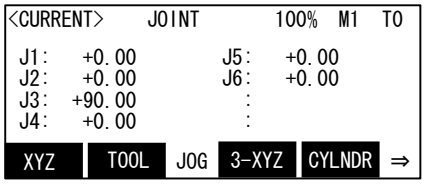


*The Position of the end axis will not change.

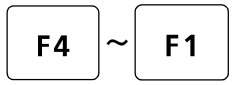
・When the[+C (J6)] keys are pressed, the J4−axis will rotate in the plus direction.
When the[−C (J6)] keys are pressed, Rotate in the minus direction.

(5) CYLNDER jog operation

Select cylindrical jog mode

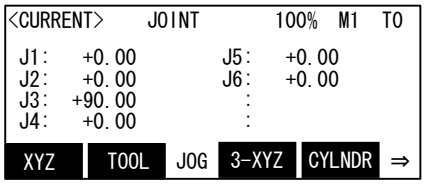


CYLNDER jog mode

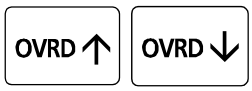


[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "CYLNDER" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "CYLNDER." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Set jog speed

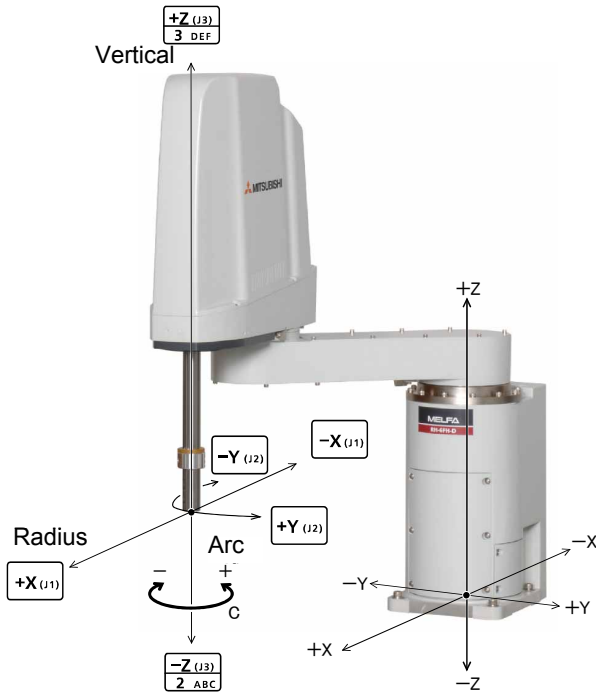


Setting the speed



Whenever it presses the key of [OVRD ↑], the override goes up. Conversely, if the [OVRD ↓] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

Moving along an arc centering on the Z axis

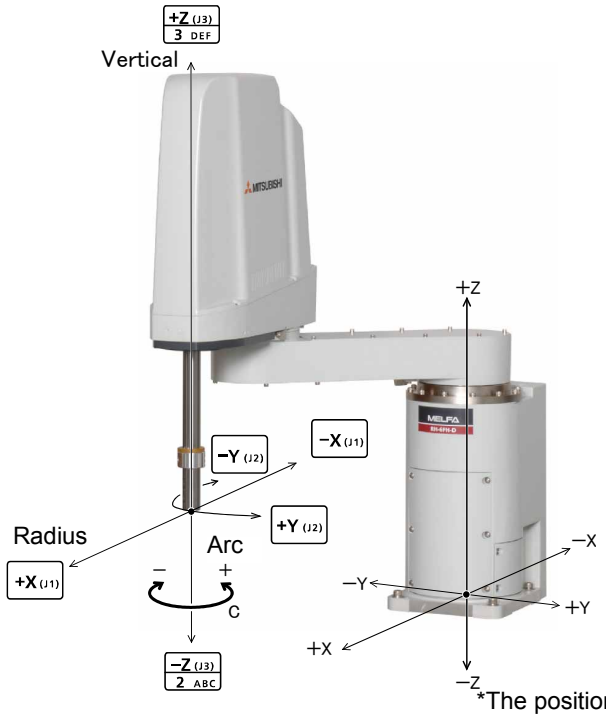


＊ The direction of the frange will not change.

Assuming that the current position is on an arc centering on the Z axis, the robot moves along that arc.

- When the[+X (J1)] keys are pressed, the robot will expand in the radial direction.
  When the[−X (J1)] keys are pressed, Contract in the radial direction.
- When the[+Y (J2)] keys are pressed, the robot will move along the arc in the plus direction.
  When the[−Y (J2)] keys are pressed, Move in the minus direction.
- When the[+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction.
  When the[−Z (J3)] keys are pressed, Move along the minus direction.

Changing the flange surface posture



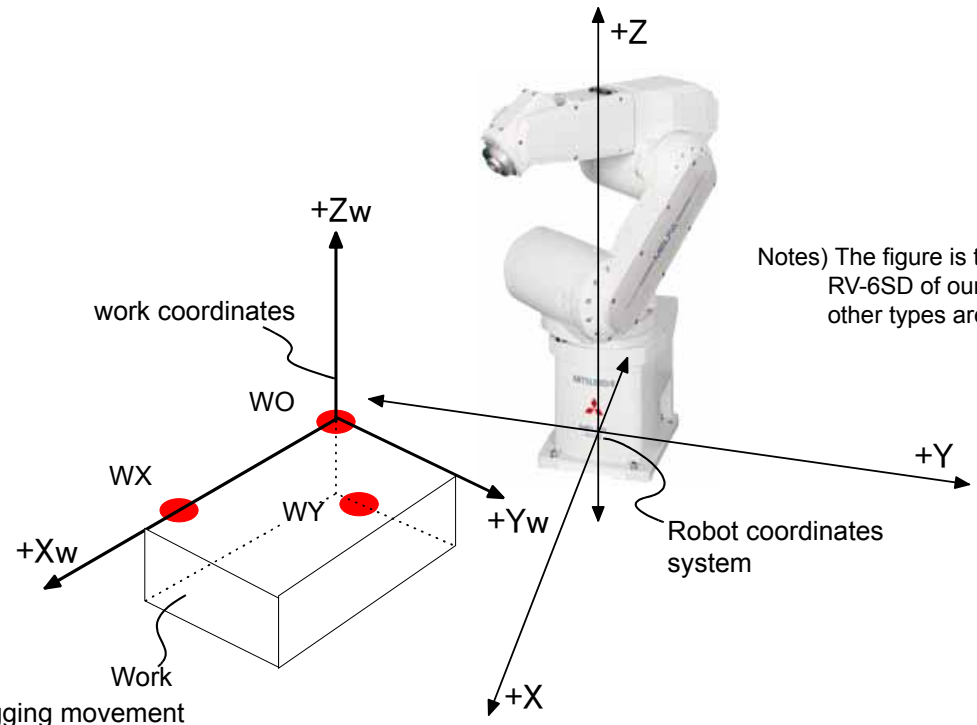
*The position of the end axis will not change.

・When the [+C (J6)] keys are pressed, The Z axis will rotate in the plus direction.
When the [−C (J6)] keys are pressed, Rotates in the minus direction.

(6) Work jog operation

Setting of the work coordinates system is necessary.
By this jog operation, robot can be move along with the direction of work (or working table etc.), so teaching operations get easier.
When jog operation, select by which work coordinates the robot moves
The setting method of the work coordinates system using T/B (R32TB) is shown in the following.
(Parameter: Setting the coordinate value to WKnCORD ("n" is meaning the number (1-8) of work coordinates) can also set up the work coordinates system. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details of parameter.)

The work coordinates system teaches and sets up the three points (WO, WX, WY).



Notes) The figure is the example of RV-6SD of our company, but other types are the same

The jogging movement based on this work is possible.

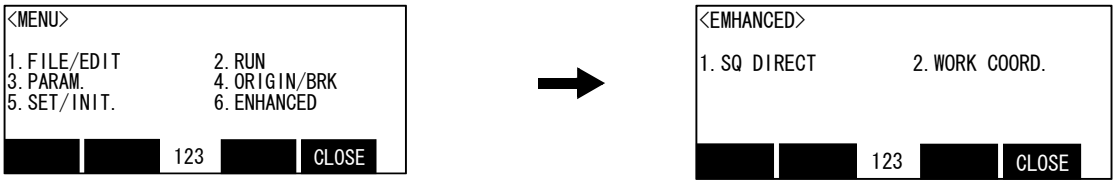
< ● Teaching point>
WO: Work coordinates system origin
WX: Position on the "+X" axis of work coordinates system.
WY: Position at the side of "+Y" axis on the X-Y plane of work coordinates system

[Supplement] : The coordinate values which use all three teaching points for setting of the work coordinates system are each only X, Y, and the Z-axis. Although the coordinate value of A, B, and C axis is not used, positioning will get easy if the XYZ jog or TOOL jog movement is effected with the same value. (The direction of the hand is the same)

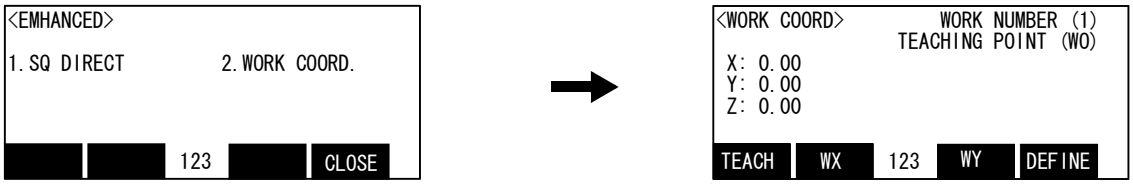
Fig.2-22 : Setting of the work coordinates system (teaching point)

The setting (definition) method of the work coordinates system is shown in the following.

1) Select "6.ENHANCED" screen on the <MENU> screen.

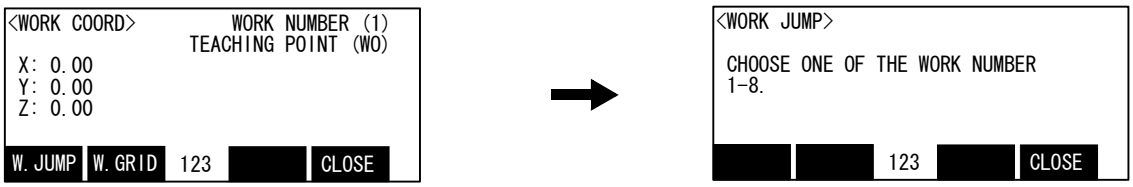


2) Press the [2] keys in the menu screen and select "2. WORK COORD."

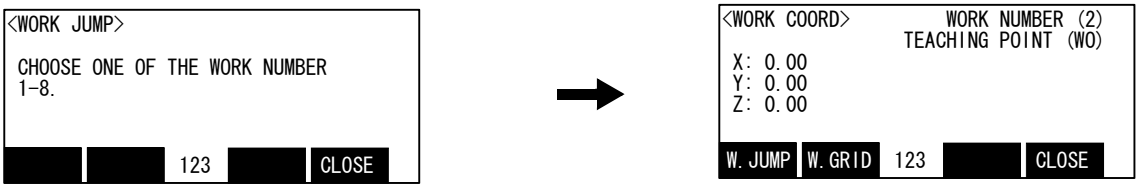


The screen shows the coordinate value of the origin (WO) of the work coordinates number 1.

3) Selection of the work coordinates number
Press the [FUNCTION] keys, and display "W: JUMP" function. Press the function key corresponding to "W: JUMP"



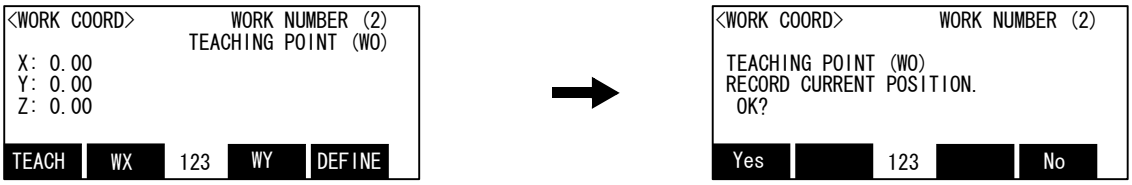
Press numeral key [1] - [8] and specify the work coordinates number. The coordinate value of the specified work coordinates system is displayed.



Operation will be canceled if the [CLOSE] key is pressed.

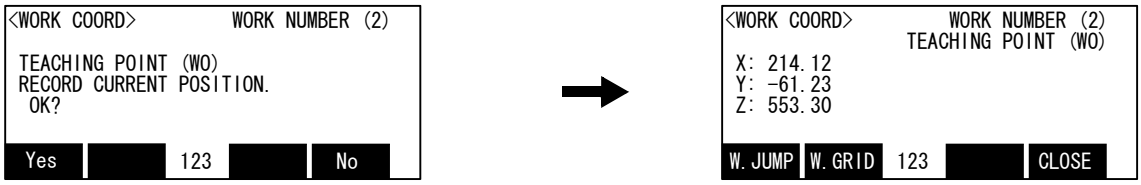
The screen is the example which specified the work coordinates number 2. ("2" at the upper right of the screen)

4) The teaching of the work coordinates system
Teach the three points shown in Fig. 2-22. Confirm the name currently displayed on the "TEACHING POINT" at the upper right of the screen. If it differs, press the function key corresponding to each point(WO, WX, WY) to teach. Move the robot's arm by jog operation (other jogging movement), and press the function key corresponding to "TEACH."([F1]) The confirmation screen is displayed.



Specify the teaching point [WO],[WX],[WY] teaching the position [TEACH]

Presses the function key corresponding to"Yes", the robot's current position is registered, and the registered coordinates value is displaye. Operation will be canceled if the [CLOSE] key is pressed.

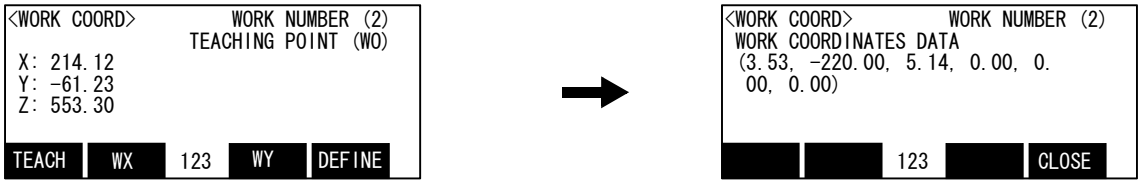


Teach the three points, WO, WX, and WY, by the same operation.
The position data taught here is each registered into the following parameters. ("n" means the work coordinates numbers 1-8)

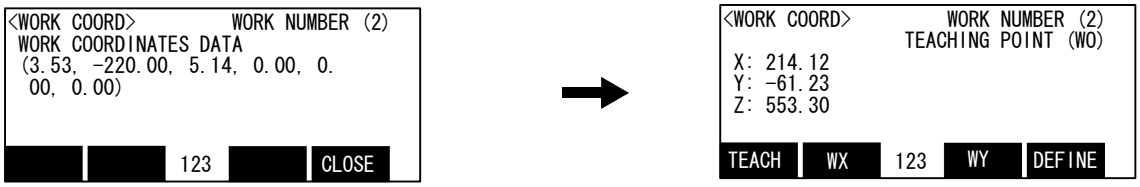
WO= parameter: WKnWO
WX= parameter: WKnWX
WY= parameter: WKnWY

5) Setting of work coordinates (definition)

If the function key corresponding to "DEFINE" ([F1]) is pressed, the work coordinates system will be calculated using the three points, and the result will be displayed.

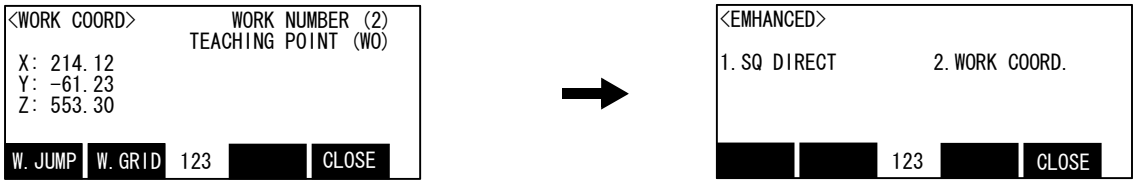


The alarm occurs if the work coordinates system is incalculable. (There are the three points on the straight line, or the two points have overlapped) In this case, reset alarm and re-teach the three points.
This work coordinate data is registered into parameter: WKnCORD. ("n" means the work coordinates numbers 1-8)
If the function key corresponding to "CLOSE" is pressed, it will return to the previous screen.

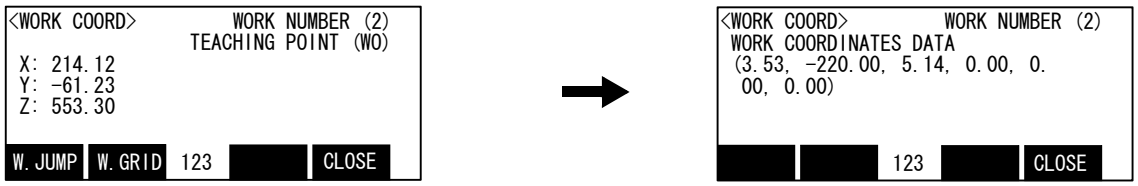


6) Finishing of setting the work coordinates

Press the [FUNCTION] keys, and display "CLOSE" function. Press the function key corresponding to "CLOSE". Returns to the <MENU> screen.



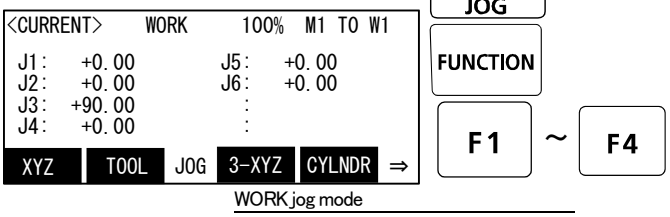
Although setting of work coordinates is finishing above, confirmation of work coordinates can be done by pressing the function key corresponding to "W GRID."([F2])



Return to the previous screen by pressing the [CLOSE] ([F4]) key.

Then, the operation method of the work jog is shown.
Change to the work jog after nearing the work.

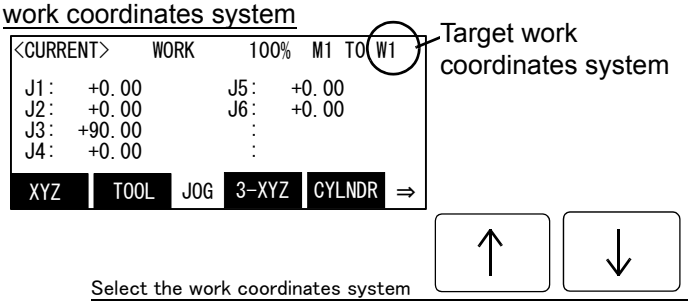
Select WORK jog mode



WORK jog mode

[JOG] Press the key and display the jog screen. ("JOG" is displayed on the screen bottom)
Check that the "WORK" in jog mode is displayed on the screen.
If other jog modes are displayed, please press the function key corresponding to the "WORK." (If the jog mode which he wishes under the screen is not displayed, it is displayed that the [FUNCTION] key is pressed)
If it finishes jog operation, press the [JOG] key again, or function key which correspond to "close."

Confirmation and selection of the work coordinates system



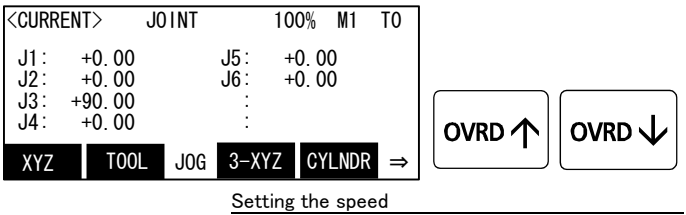
Select the work coordinates system

Confirm the target work coordinates system.
The current target number is displayed on the screen upper right. (W1 - W8)
The number of work coordinates can be changed by the arrow key [Upper arrow], [Lower arrow]
Push the key [Upper arrow], the number will increase. (W1, W2, ... W8) Conversely, push the key [Lower arrow], the number will decrease

⚠ CAUTION

Always confirm that the number of the target work coordinates system is displayed correctly (Display of W1-W8 at the upper right of the screen)
If mistaken, the robot will move in the direction which is not meant and will cause the damage and the personal injuries.

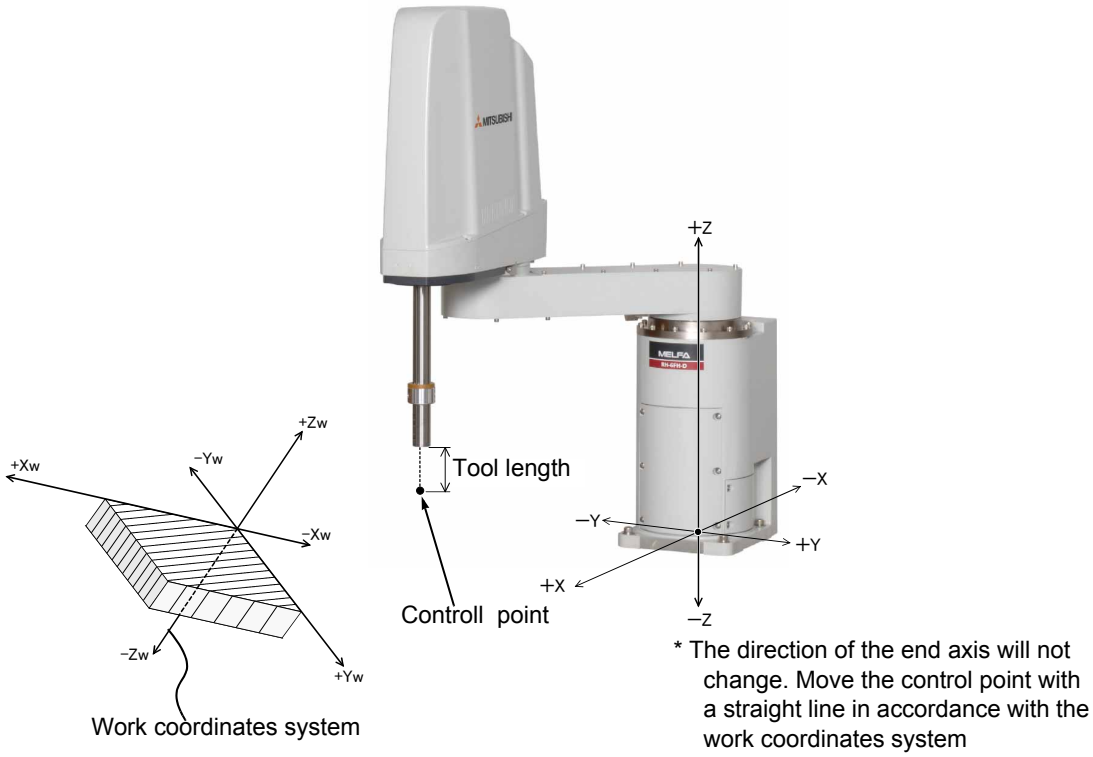
Set jog speed



Setting the speed

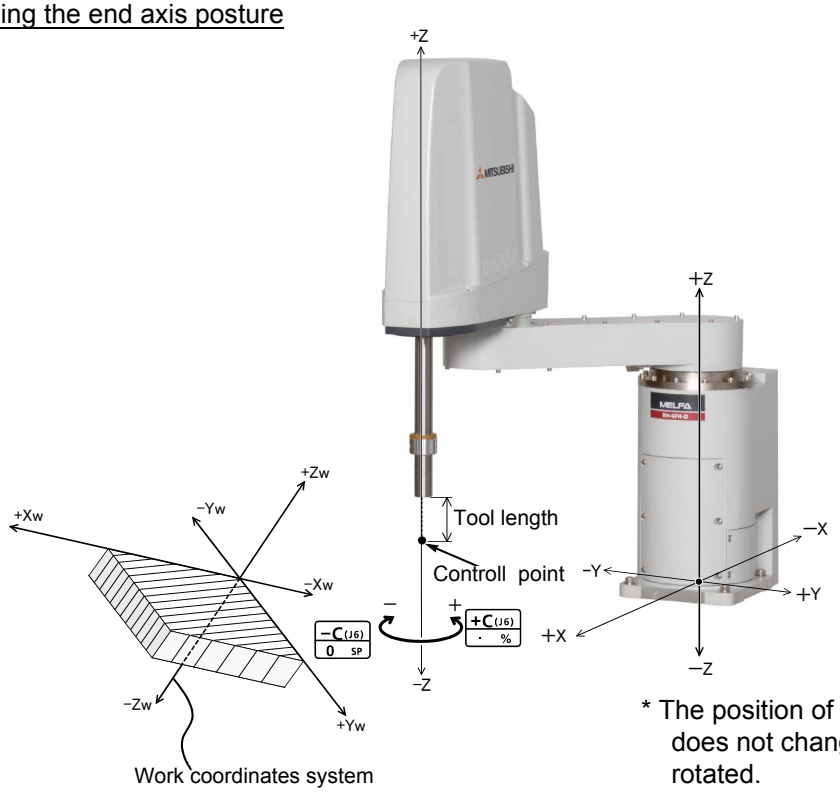
Whenever it presses the key of [OVRD(Upper arrow)], the override goes up. Conversely, if the [OVRD(Lower arrow)] key is pressed, it will go down.
The current setting speed is displayed on screen upper right, and "STATUS NUMBER" of the controller.
Set the override to 10% here for confirmation work

The jog movement based on work coordinates system



- When the[+X (J1)] keys are pressed, the robot will move along the X axis plus direction on the work coordinates system.
  When the[-X (J1)] keys are pressed, Move along the minus direction.
- When the[+Y (J2)] keys are pressed, the robot will move along the Y axis plus direction on the work coordinates system.
  When the[-Y (J2)] keys are pressed, Move along the minus direction.
- When the[+Z (J3)] keys are pressed, the robot will move along the Z axis plus direction on the work coordinates system.
  When the[-Z (J3)] keys are pressed, Move along the minus direction.

Changing the end axis posture



* The position of the control point does not change. The end axis is rotated.

・When the[+C (J6)] keys are pressed, The Z axis will rotate in the plus direction of the XYZ coordinate system. When the[−C (J6)] keys are pressed, Rotate in the minus direction.

◇◆◇ When the robot is in the transportation posture ◇◆◇

There are directions from which linear movement is not possible from the transportation posture. In this case, the robot will not move. Refer to section "(1)JOINT jog operation" on page 30", and move the robot to a position where linear movement is possible, and then carry out XYZ jog.

◇◆◇If the buzzer of T/B sounds and the robot does not move ◇◆◇

If it is going to move the robot across the operation range, the buzzer of T/B sounds and the robot does not move. In this case, please move to the counter direction.

◇◆◇ Tool length ◇◆◇

The default tool length is 0mm, and the control point is the center of the end axis.
After installing the hand, set the correct tool length in the parameters. Refer to the separate manual "Detailed Explanation of Functions and Operations" for details.

3 Installing the option devices

3.1 Installing the solenoid valve set

The installation summary of the solenoid valve is shown in Fig. 3-1. Remove the No.2 arm cover U, and install the solenoid valve on the No.2 arm. Turn the controller's power OFF before this installing operation. Refer to Page 62, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

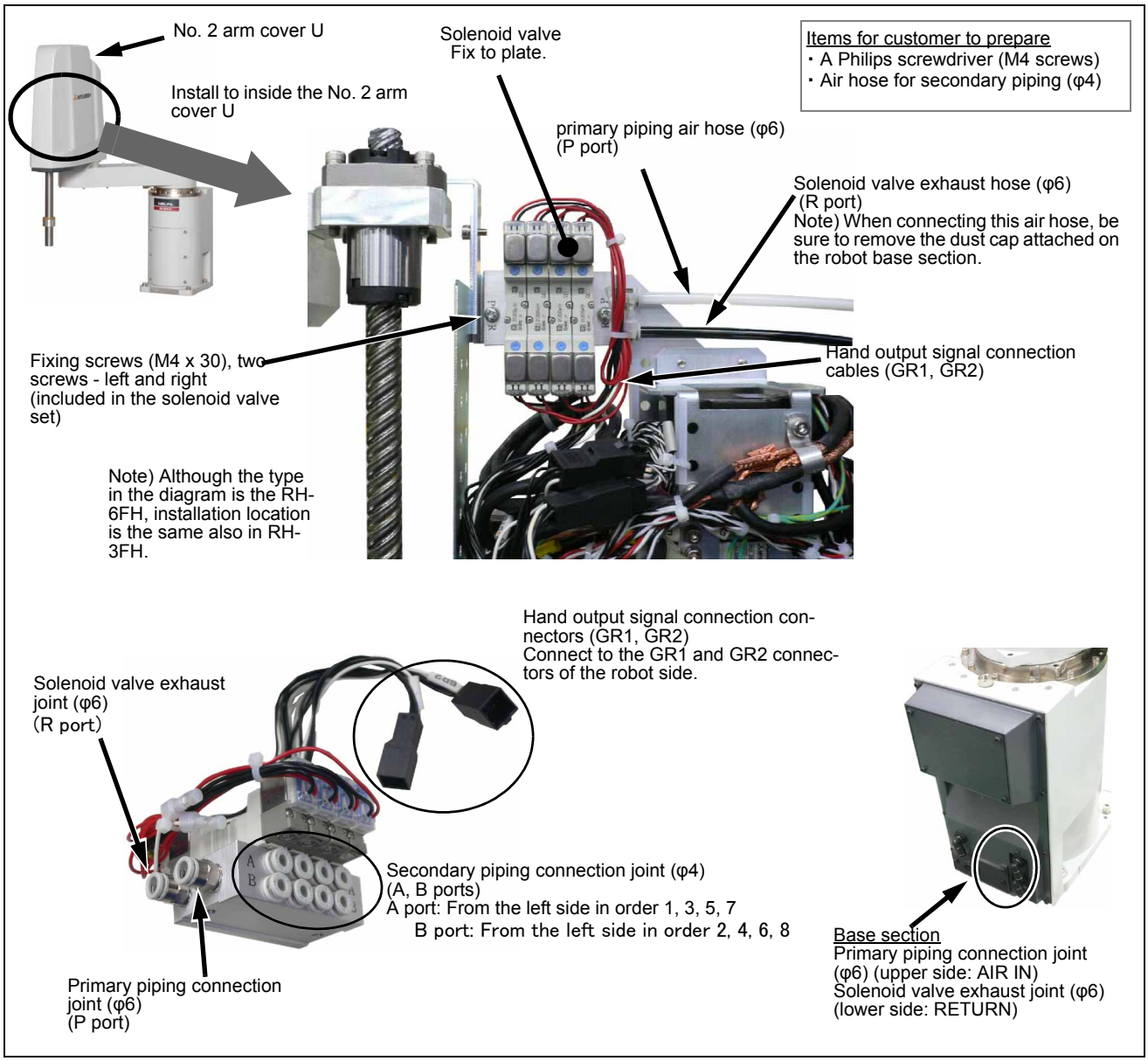

No. 2 arm cover U
Solenoid valve
Fix to plate.
Items for customer to prepare
・A Philips screwdriver (M4 screws)
・Air hose for secondary piping (φ4)
Install to inside the No. 2 arm cover U
primary piping air hose (φ6)
(P port)
Solenoid valve exhaust hose (φ6)
(R port)
Note) When connecting this air hose, be sure to remove the dust cap attached on the robot base section.
Fixing screws (M4 x 30), two screws - left and right (included in the solenoid valve set)
Hand output signal connection cables (GR1, GR2)
Note) Although the type in the diagram is the RH-6FH, installation location is the same also in RH-3FH.
Hand output signal connection connectors (GR1, GR2)
Connect to the GR1 and GR2 connectors of the robot side.
Solenoid valve exhaust joint (φ6)
(R port)
Secondary piping connection joint (φ4)
(A, B ports)
A port: From the left side in order 1, 3, 5, 7
B port: From the left side in order 2, 4, 6, 8
Primary piping connection joint (φ6)
(P port)
Base section
Primary piping connection joint (φ6) (upper side: AIR IN)
Solenoid valve exhaust joint (φ6) (lower side: RETURN)

Fig.3-1 : Solenoid valve installation procedures (RH-3FH/6FH)

The installation procedure is detailed below.

1) Remove the screws fixing the No. 2 arm cover U, and remove the No. 2 arm cover U.
2) Fix the solenoid valve to the plate in the position indicated in Fig. 3-1.Place it so that the solenoid valve's primary piping connection joints (P, R ports) are located on the right hand side, and fix it securely using the M4 screws included (tightening torque: 1.39 to 1.89N・m).
3) Connect the connector (GR1, GR2) of solenoid valve with connector of robot arm side (GR1, GR2). Connect with the same names. The hand output signal cables of the robot arm side are located close to where the solenoid valve is installed and are tied up with cable tie. Cut the cable tie and connect them to the connectors.

4) Connect the primary piping air hose (φ6). The air hoses are located close to where the solenoid valve is installed and are tied up with cable tie. Cut the cable tie and connect them. Of the two air hoses, connect the one marked "AIR IN" to the solenoid valve's P port, and the one marked "RETURN" to the R port.
   Note) When connecting the RETURN air hose, be sure to remove the dust cap attached at the RETURN joint on the robot base section. If the cap is not removed, exhaust air pressure will increase and the solenoid valve may not operate properly.By connecting the exhaust air hose (φ6: customer preparation) to this RETURN air joint, exhaust air from the solenoid valve is able to escape to the designated point.
5) Connect the secondary piping air hose (φ4).
   The optional hand curl tube, the hand internal wiring and piping set, or the air hose prepared by customer can all be used, however when pulling the tip of the air hose out from the shaft please be sure to use the optional hand internal wiring and piping set.
   Connect the air hoses to solenoid valve port A and port B. Please refere to Table 3-1 and connect to the necessary ports. Cover the unused solenoid valve joints with the plugs included.
   Note) When pulling the tip of the air hose out from the shaft, please be sure to use the optional hand internal wiring and piping set. A plate that can be fixed to an appropriate position and silicon grease to apply to friction points, are both included with the product (please refer to Page 51, "3.4 Hand internal wiring and piping set"). Further, when using the optional external wiring and piping box, the air hose can be pulled out from the rear of the No. 2 arm (please refer to Page 54, "3.5 External Wiring and Piping Box").
6) If the hand output cable and the air hose have excess length, please tie the excess section by cable tie and fix it to the plate. The plate have some holes for fixing the cable/hose with a cable tie.
7) Install securely the No.2 arm cover U as before with fixing screws (tightening torque: 1.39 to 1.89 Nm).
   Note) The installation surface of the clean and the oil-mist specification covers is using sealing material. In the event that the sealing material has been removed or has been bent or broken to the extent that it cannot be return to the original form, be sure to replace the sealing material. Please contact dealer when the sealing material needs to be replaced.

This completes installing the solenoid valve set.

The connection correspondence after installation is as shown in Table 3-1.

Table 3-1 : Solenoid valve ports and hoses: Correspondence of couplings and hand ports

Hand	Hand port	Solenoid valve port	Solenoid valve used
Hand 1	OPEN	1	1 st row
	CLOSE	2	
Hand 2	OPEN	3	2 nd row
	CLOSE	4	
Hand 3	OPEN	5	3 rd row
	CLOSE	6	
Hand 4	OPEN	7	4 th row
	CLOSE	8	

3.2 Installing the hand input cable

Fig. 3-2 shows the hand input cable's storage location on the robot.
Please use the optional external wiring and piping box to pull the hand input cable out externally. After connecting the hand input cable connector, reference Page 54, "3.5 External Wiring and Piping Box", and pull it out from the robot arm.
When passing through the inside of the shaft and using it, please use the optional hand internal wiring and piping set.
Remove the No. 2 arm cover U and connect the connector above the No. 2 arm. Turn the controller's power OFF before this operation. Refer to Page 62, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

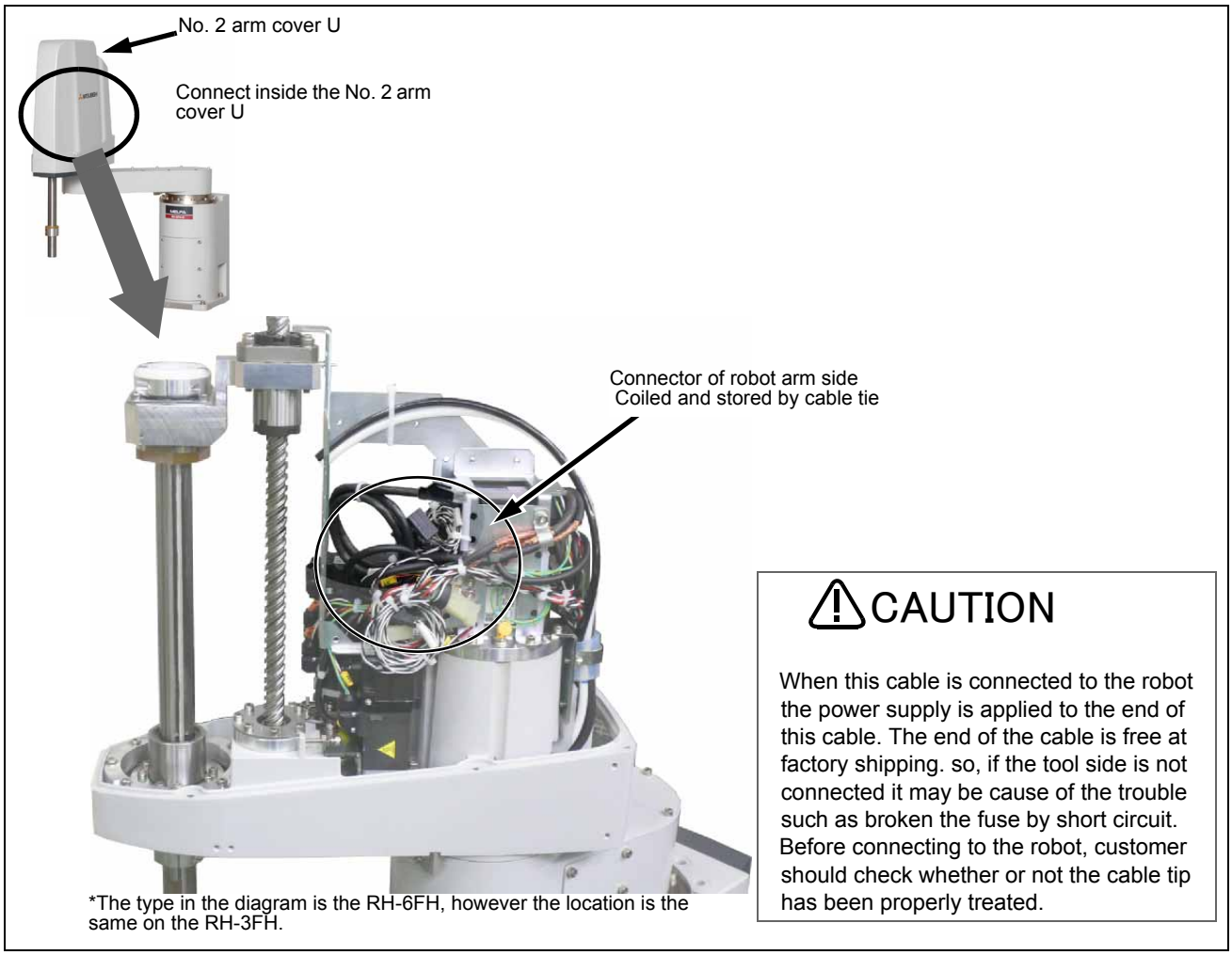

No. 2 arm cover U
Connect inside the No. 2 arm cover U
Connector of robot arm side
Coiled and stored by cable tie
*The type in the diagram is the RH-6FH, however the location is the same on the RH-3FH.
CAUTION
When this cable is connected to the robot the power supply is applied to the end of this cable. The end of the cable is free at factory shipping. so, if the tool side is not connected it may be cause of the trouble such as broken the fuse by short circuit. Before connecting to the robot, customer should check whether or not the cable tip has been properly treated.

Fig.3-2 : Installing the hand input cable

The installation procedure for the hand input cable is shown below

1) Remove the screws fixing the No. 2 arm cover U, and remove the No. 2 arm cover U.
2) The hand input cable is stored in the location shown in Fig. 3-2. Remove cable tie, and check the connectors (HC1, HC2).
3) Connect the connector (HC1,HC2) of optional cable with connector of robot arm side (HC1, HC2). Connect with the same names.
4) Pull the hand input cables out of the robot arm. Referencing Page 54, "3.5 External Wiring and Piping Box", pull the cable out.

When installation of the optional external wiring and piping box finished, Installing the hand input cable is complete.

3.3 Installing the hand output cable

Fig. 3-3 shows the hand output cable's storage location on the robot.
Please use the optional external wiring and piping box to pull the hand output cable out externally. After connecting the hand output cable connector, reference Page 54, "3.5 External Wiring and Piping Box", and pull it out from the robot arm.
Remove the No. 2 arm cover U and connect the connector above the No. 2 arm. Turn the controller's power OFF before this operation. Refer to Page 62, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

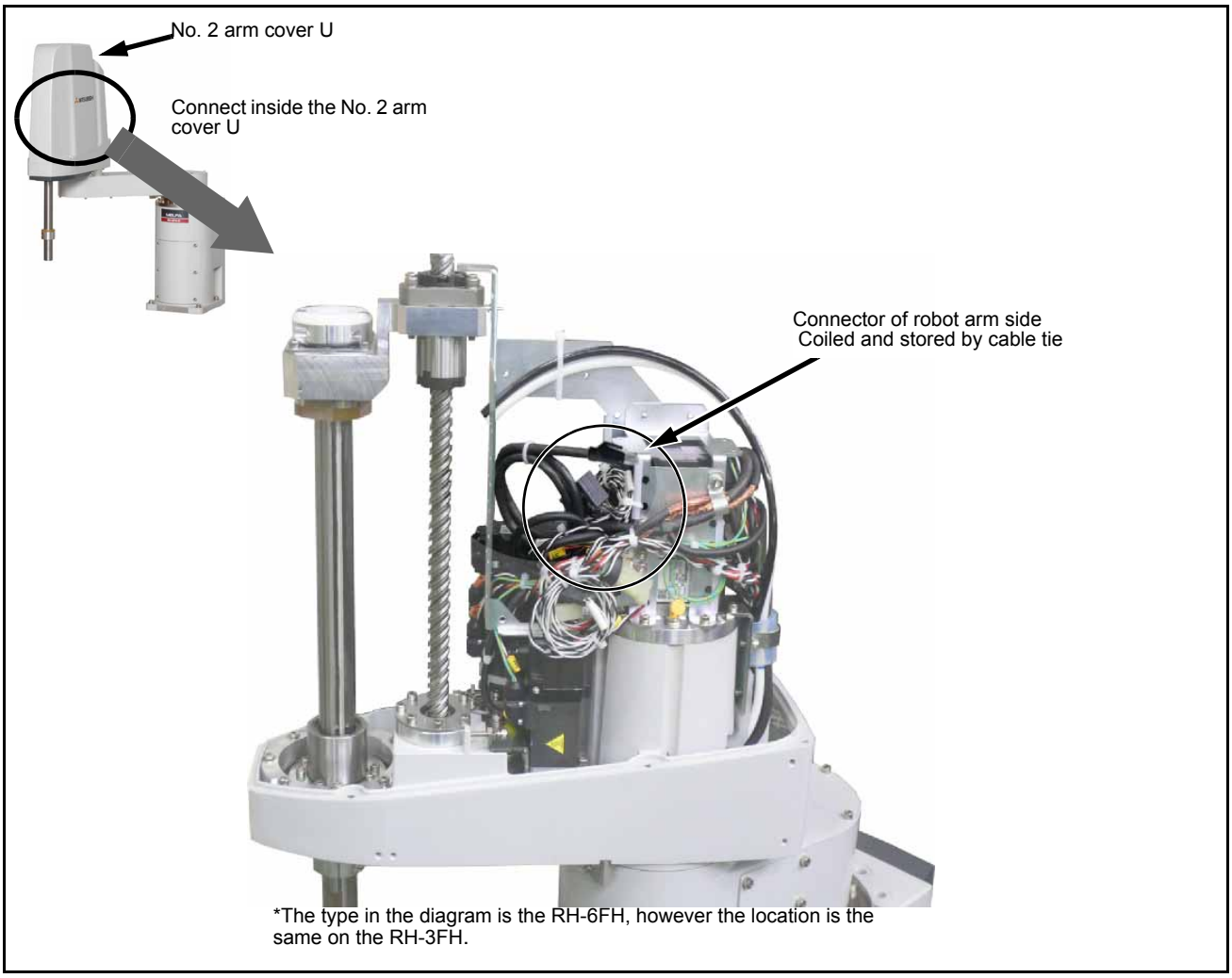

No. 2 arm cover U
Connect inside the No. 2 arm cover U
Connector of robot arm side
Coiled and stored by cable tie
*The type in the diagram is the RH-6FH, however the location is the same on the RH-3FH.

Fig.3-3 : Installing the hand output cable

The installation procedure for the hand output cable is shown below

1) Remove the screws fixing the No. 2 arm cover U, and remove the No. 2 arm cover U.
2) The hand output cable is stored in the location shown in Fig. 3-3. Remove cable tie, and check the connectors (GR1, GR2).
3) Connect the connector (GR1, GR2) of optional cable with connector of robot arm side (GR1, GR2). Connect with the same names.
4) Pull the hand output cables out of the robot arm. Referencing Page 54, "3.5 External Wiring and Piping Box", pull the cable out.

When installation of the optional external wiring and piping box finished, Installing the hand output cable is complete.

3.4 Hand internal wiring and piping set

The installation procedure for the hand internal wiring and piping set is shown in Fig. 3-4 for the RH-3FH series, and in Fig. 3-5 for the RH-6FH series. Remove the No. 2 arm cover U and fix this option to the plate above the No. 2 arm.

Turn the controller's power OFF before this operation. Refer to Page 62, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

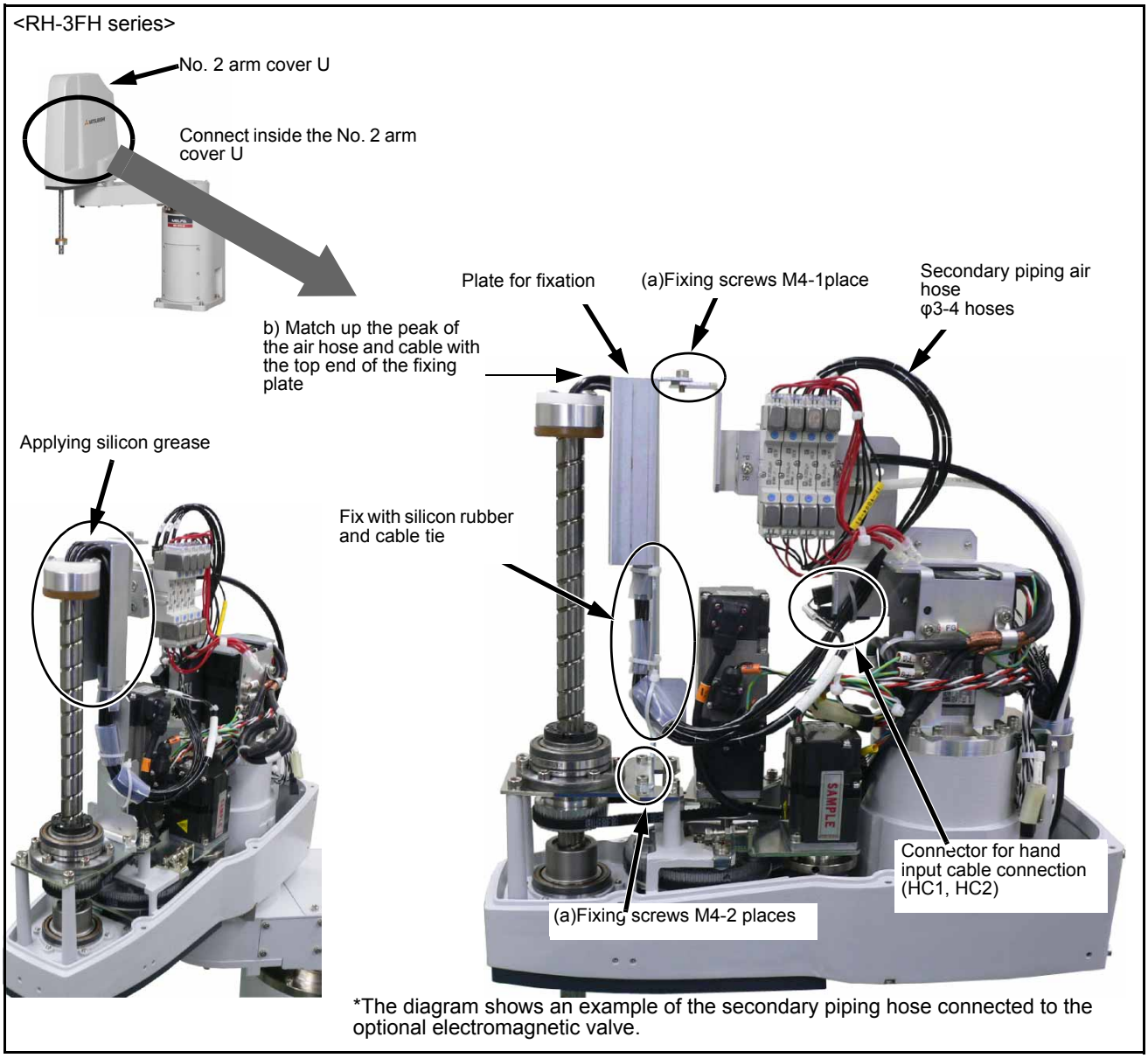

<RH-3FH series>
No. 2 arm cover U
Connect inside the No. 2 arm cover U
Plate for fixation
(a)Fixing screws M4-1place
Secondary piping air hose
φ3-4 hoses
b) Match up the peak of the air hose and cable with the top end of the fixing plate
Applying silicon grease
Fix with silicon rubber and cable tie
Connector for hand input cable connection (HC1, HC2)
(a)Fixing screws M4-2 places
*The diagram shows an example of the secondary piping hose connected to the optional electromagnetic valve.

Fig.3-4 : Installing the hand internal wiring and piping set (RH-3FH)

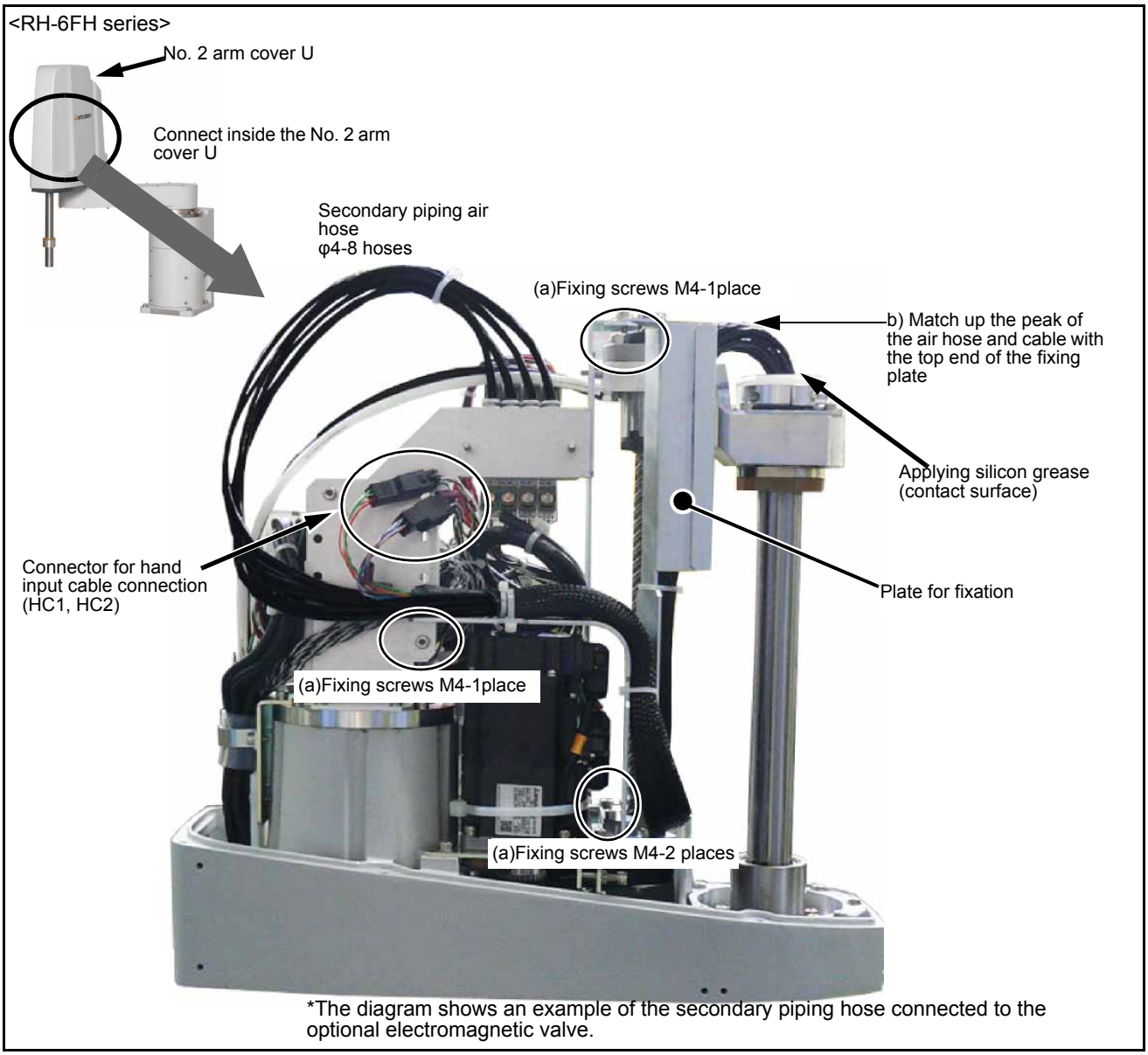

<RH-6FH series>
No. 2 arm cover U
Connect inside the No. 2 arm cover U
Secondary piping air hose
φ4-8 hoses
(a)Fixing screws M4-1place
b) Match up the peak of the air hose and cable with the top end of the fixing plate
Applying silicon grease (contact surface)
Connector for hand input cable connection (HC1, HC2)
Plate for fixation
(a)Fixing screws M4-1place
(a)Fixing screws M4-2 places
*The diagram shows an example of the secondary piping hose connected to the optional electromagnetic valve.

Fig.3-5 : Installing the hand internal wiring and piping set (RH-6FH)

The installation procedure is shown below.

1) Move the J3 axis to the top end with a jog operation and shut off the controller's power supply. This is necessary for space standard settings when feeding the air hose and hand input cable through the inside of the shaft.
2) Remove the screws fixing the No. 2 arm cover U, and remove the No. 2 arm cover U.
3) Attach the optional fixing plate to the robot's metal plate using fixing screws, as shown in the diagram. (shown in the diagram's "(a)" section). The RH-3FH series has a total of 3 screws and the RH-6FH series has a total of 4 screws. Be sure to fasten with fixing screws and install securely.
4) When using the hand input cable connect the connectors (HC1, HC2) of optional hand input cable to connectors (HC1, HC2) of robot side. Connect with the same names.
   The connectors of robot side are tied up by cable tie. Cut the cable tie and pull them out.
   When the hand input cable is not used tie up the connector and fix to the plate by cable tie. The plate have some holes for fixing the cable/hose with a cable tie.
5) Connect the secondary piping air hose.
   Although the diagram shows an example which connected the optional solenoid valve, the cables and hoses can be pulled out out of the robot from rear of the No.2 arm by using optional "external wiring and piping box". Refer to Page 54, "3.5 External Wiring and Piping Box" for how to pull it out.

When using the optional solenoid valve connect to the A port or B port of solenoid valve.
Refer to Page 47 "Fig. 3-1Solenoid valve installation procedures (RH-3FH/6FH)" and Page 48 "Table 3-1 : Solenoid valve ports and hoses: Correspondence of couplings and hand ports" for connect to the port necessary.

6) Fix the cables and hoses to the plate by using silicon rubber and cable tie attached. (three points)
7) Feed through inside the shaft the tool (hand) side of the hand input cables and the secondary piping air hoses.

⚠CAUTION In order to give the air hose and cable an appropriate space, the highest point of the curved section of the air hose and cable should be matched up with the top of the fixing plate, and fix at the tool side as is shown in section (a) of the diagram.
If the air hose and cable are fixed with no space, more friction will be applied at the top of the shaft or bent when operating the robot, so, it becomes the cause which the operation of tool (hand) is abnormal or breaks the wire

8) Do the wiring and piping of tool side.
9) Apply the attached silicon grease to the top of shaft and the surface where the air hose and the hand input cable contact the fixing plate.
10) If the hand input cable and the air hose have excess length, please tie the excess section by cable tie and fix it to the plate. The plate have some holes for fixing the cable/hose with a cable tie.
11) Install securely the No.2 arm cover U as before with fixing screws (tightening torque: 1.39 to 1.89 Nm).
Note) The installation surface of the clean and the oil-mist specification covers is using sealing material. In the event that the sealing material has been removed or has been bent or broken to the extent that it cannot be return to the original form, be sure to replace the sealing material. Please contact dealer when the sealing material needs to be replaced.

This completes installing the Hand internal wiring and piping set.

3.5 External Wiring and Piping Box

The air hose that is connected inside the robot, the optional hand output cable, the hand input cable, etc., can all be pulled out from the rear of the No. 2 arm.
These can be used to connect a customer supplied solenoid valve to the hand output cable, etc.

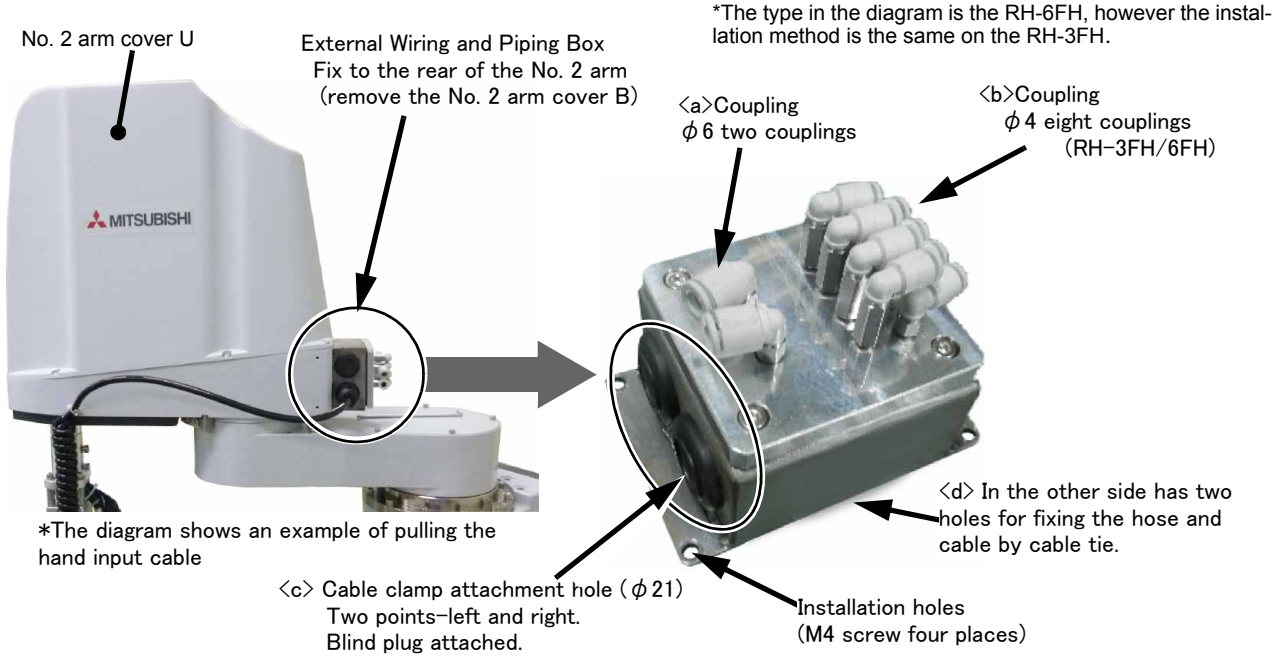

*The type in the diagram is the RH-6FH, however the installation method is the same on the RH-3FH.
No. 2 arm cover U
External Wiring and Piping Box
Fix to the rear of the No. 2 arm
(remove the No. 2 arm cover B)
<a>Coupling
φ6 two couplings
<b>Coupling
φ4 eight couplings
(RH-3FH/6FH)
MITSUBISHI
*The diagram shows an example of pulling the hand input cable
<d> In the other side has two holes for fixing the hose and cable by cable tie.
<c> Cable clamp attachment hole (φ21)
Two points-left and right.
Blind plug attached.
Installation holes
(M4 screw four places)

Table 3-2 : Hose and cables which can be pulled out

No	Air hoses/cables	Position to pull out		Example usage
(1)	Primary piping air hose (φ6-2 hoses) (The primary piping is equipped from rear of base to No. 2 arm)	<a>	Coupling φ6 two couplings	Primary air supply to externally installed solenoid valve.
(2)	Secondary piping air hose (φ4-8 hoses: RH-3FH/6FH) (Air hose of the optional hand internal wiring and piping set or prepared by the customer)	<b>	Coupling φ8 eight couplings	Taking in the secondary air from externally installed solenoid valve. Pulling out the secondary air from optional solenoid valve.
(3)	Optional hand output cable	<c>	φ21 hole four place	For driving the externally installed solenoid valve.
(4)	Optional hand input cable			Taking in the input signals from tools such as the hand.

Note) Fix all with cable tie (sections <d> and <e> of the diagram)

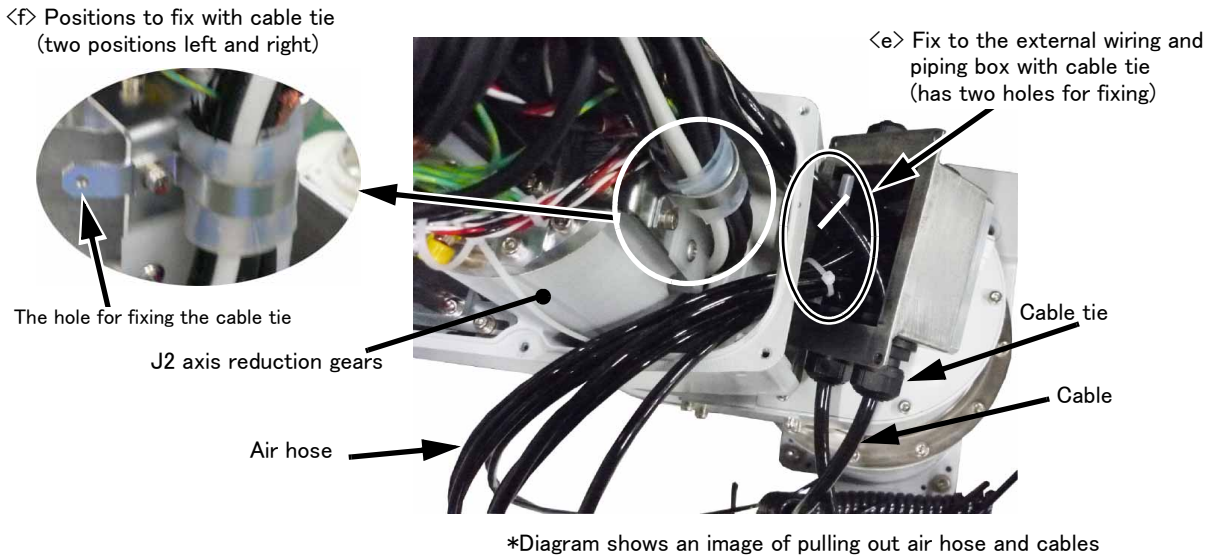

<f> Positions to fix with cable tie
(two positions left and right)
<e> Fix to the external wiring and piping box with cable tie
(has two holes for fixing)
The hole for fixing the cable tie
J2 axis reduction gears
Cable tie
Cable
Air hose
*Diagram shows an image of pulling out air hose and cables

Fig.3-6 : External Wiring and Piping Box

Fig. 3-6 shows the installation procedure for the external wiring and piping box. The procedure is the same in RH-3FH/6FH. Remove the No. 2 arm cover B and install this option using the same screw holes. The installation procedure is shown below.
Turn the controller's power OFF before this operation. Refer to Page 62, "5.3.2 Installing/removing the cover" for removing/ installing the cover.

1) Remove the each fixing screws and remove the No. 2 arm cover U and the No. 2 arm cover B.
2) Pull out the air hoses or cables from the opening which removed the No. 2 arm cover B.
3) Fix (or connect) the air hoses and cables to this option box.
   Previously adjust the air hose and cables to an appropriate length. Make sure that the wiring and piping lines avoid the side of the J2 reducer (because gap is narrow, it interfere with the No. 2 arm cover U).
   Connect the air hoses with the joint inside this option box.
   Remove the blind plug attached to this option box and fix the cable with the cable clamp.

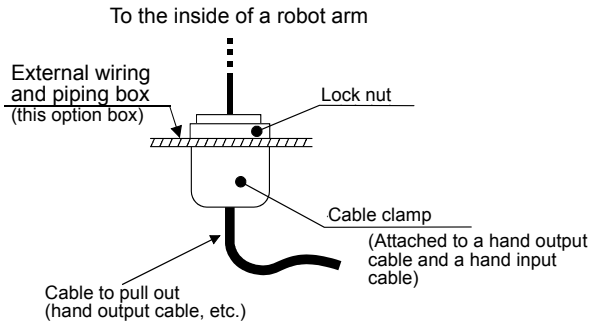


Fig.3-7 : Fixing the Cable

4) Fix the air hoses and cables to the hole inside of this box by using the attached cable tie. (section <e> of Fig. 3-6)
   Note) Be sure to fix the air hoses and cables to prevent the hoses falling out and breaking the cable. Also, fix carefully so that the air hose and cables may not be pulled too much.
5) Install securely the external wiring and piping box to the screw holes that previously installed the No. 2 arm cover B by attached screw. (tightening torque: 1.39 to 1.89Nm).
   When installing pull it little by little from the No. 2 arm side, making sure that the air hose and cables are not bent or trapped.
6) Make sure that the wiring and piping lines on the No.2 arm avoid the side of the J2 reducer (because gap is narrow, it interfere with the No. 2 arm cover U).
   Fix the hoses and cables to the hole shown in section <f> of Fig. 3-6 using cable tie. There are 2 holes, located left and right.
7) If the cables and the air hoses have excess length, please tie the excess section using cable tie.
8) Install securely the No.2 arm cover U as before with fixing screws (tightening torque: 1.39 to 1.89 Nm).
   Note) The installation surface of the clean and the oil-mist specification covers is using sealing material. In the event that the sealing material has been removed or has been bent or broken to the extent that it cannot be return to the original form, be sure to replace the sealing material. Please contact dealer when the sealing material needs to be replaced.

This completes installing the External Wiring and Piping Box.

4 Basic operations

The basic operations from creating the program to automatic operation are explained in section ″4. Basic operations″ in the ″From Controller Setup to Maintenance″ manual. Refer that manual as necessary.

5 Maintenance and Inspection

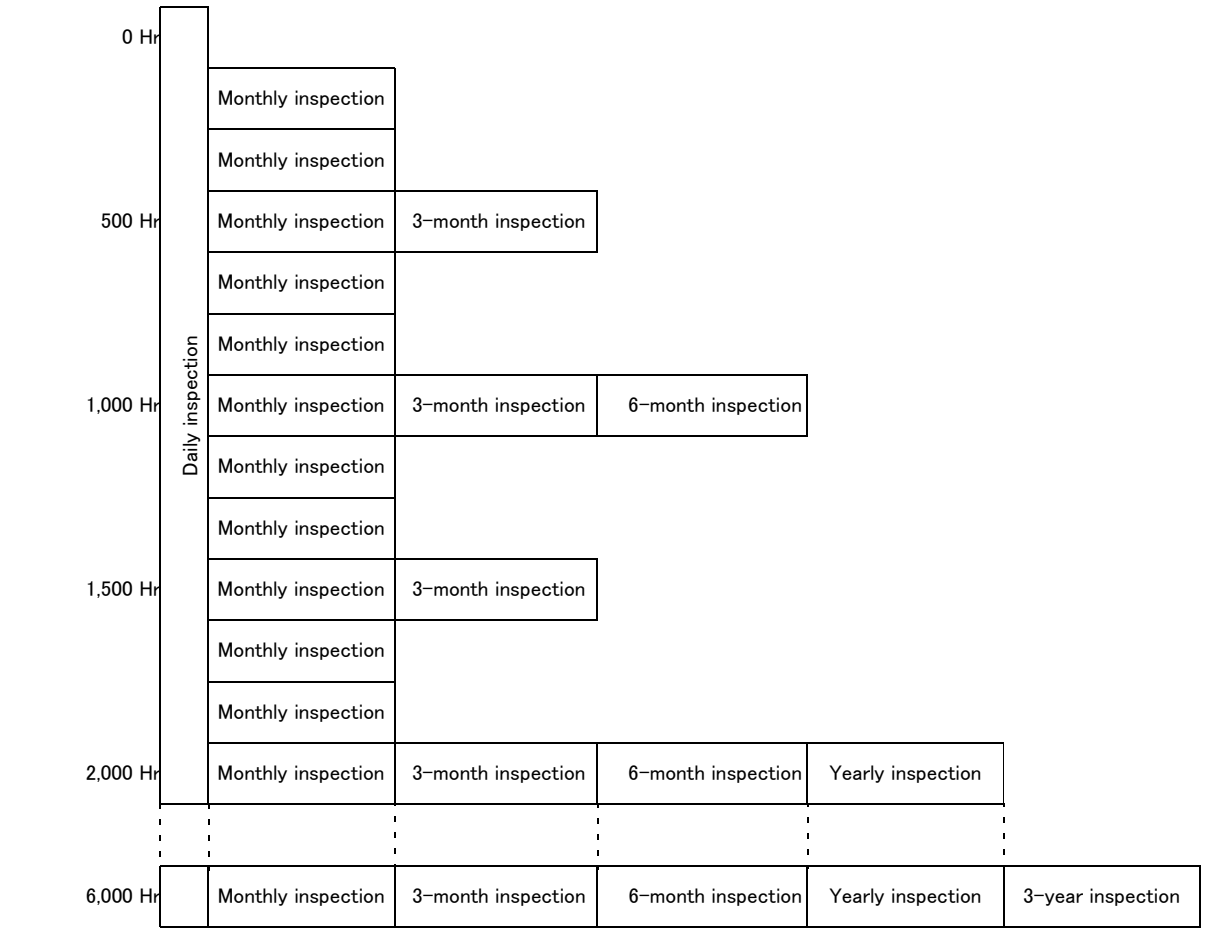
The maintenance and inspection procedures to be carried out to use the robot for a long time without trouble are described in this chapter. The types and replacement methods of consumable parts are also explained.

5.1 Maintenance and inspection interval

Maintenance and inspection are divided into the inspections carried out daily, and the periodic inspections carry out at set intervals. Always carry these out to prevent unforeseen trouble, to maintain the product for a long time, and to secure safety.

(1) Inspection schedule

In addition to the monthly inspection, add the following inspection items every three months (estimated at 500 Hr operation hours).



<Guideline for inspection period>

For one shift

8 Hr/day × 20 days/month × 3 months = approx. 500 Hr

10 Hr/day × 20 days/month × 3 months = approx. 600 Hr

For two shifts

15 Hr/day × 20 days/month × 3 months = approx. 1000 Hr

[Caution] When using two lines, the 3-month inspection, 6-month inspection and yearly inspection must be carried out when half the time has passed.

Fig.5-1 : Inspection schedule

5.2 Inspection items

The inspection items for the robot arm are shown below.
Also refer to section "5. Maintenance and inspection" in the "Controller setup, basic operation, and maintenance" manual, and inspect the controller.

5.2.1 Daily inspection items

Carry out the daily inspections with the procedures given in Table 5-1.

Table 5-1 : Daily inspection items (details)

Procedure	Inspection item (details)	Remedies
Before turning power ON (Check the following items before turning the power ON.)		
1	Are any of the robot installation bolts loose? (Visual)	Securely tighten the bolts.
2	Are any of the cover tightening screws loose? (Visual)	Securely tighten the screws.
3	Are any of the hand installation bolts loose? (Visual)	Securely tighten the bolts
4	Is the power supply cable securely connected? (Visual)	Securely connect.
5	Is the machine cable between the robot and controller securely connected? (Visual)	Securely connect.
6	Are there any cracks, foreign contamination or obstacles on the robot and controller cover?	Replace with a new part, or take remedial measures.
7	Is any grease leaking from the robot arm? (Visual)	After cleaning, replenish the grease.
8	Is there any abnormality in the pneumatic system? Are there any air leaks, drain clogging or hose damage? Is the air source normal? (Visual)	Drain the drainage, and remedy the air leaks (replace the part).
After turning the power ON (Turn the power ON while monitoring the robot.)		
1	Is there any abnormal motion or abnormal noise when the power is turned ON?	Follow the troubleshooting section.
During operation (try running with an original program)		
1	Check whether the movement points are deviated? Check the following points if there is any deviation. 1. Are any installation bolts loose? 2. Are any hand installation section bolts loose? 3. Are the positions of the jigs other than the robot deviated? 4. If the positional deviation cannot be corrected, refer to "Troubleshooting", check and remedy.	Follow the troubleshooting section.
2	Is there any abnormal motion or abnormal noise? (Visual)	Follow the troubleshooting section.

5.2.2 Periodic inspection

Carry out periodic inspection with the procedures given in Table 5-2.

Table 5-2 : Periodic inspection items (details)

Procedure	Inspection item (details)	Remedies
Monthly inspection items		
1	Are any of the bolts or screws on the robot arm loose?	Securely tighten the bolts.
2	Are any of the connector fixing screws or terminal block terminal screws loose?	Securely tighten the screws.
3	Remove the cover at each section, and check the cables for wear damage and adherence of foreign matter.	Check and eliminate the cause. If the cables are severely damaged, contact the Mitsubishi Service Department.
3-month inspection items		
1	Is the timing belt tension abnormal?	If the timing belt is loose or too tense, adjust it.
2	Is there any grease of the shaft section still?	Wipe off the old grease and supply the new grease.
6-month inspection items		
1	Is the friction at the timing belt teeth severe?	If the teeth are missing or severe friction is found, replace the timing belt.
2	Has the dust accumulated into bellows? (When environment with much dust)	Remove bellows and clean the inside. (Refer to Page 80, "5.3.5 Replacing the bellows" for how to remove bellows)
Yearly inspection items		
1	Replace the backup battery in the robot arm.	Exchange it referring to Page 84, "5.3.7 Replacing the backup battery".
3-year inspection items		
1	Replace the bellows (J3 axis). (Only clean specification and oil mist specification)	Replace it referring to Page 80, "5.3.5 Replacing the bellows"

5.3 Maintenance and inspection procedures

The procedures for carrying out the periodic maintenance and inspection are described in this section. Thoroughly read the contents, and follow the instructions. This work can be commissioned to the Mitsubishi Service Department for a fee. (Never disassemble, etc., the parts not described in this manual.)
The maintenance parts, etc., required for the customer to carry out maintenance and inspection are described in Page 87, "5.5 Maintenance parts" of this manual. Always contact your dealer when parts are needed.

⚠ CAUTION The origin of the machine system could deviate when this work is carried out. "Review of the position data" and "re-teaching" will be required.

5.3.1 Robot arm structure

The outline drawing of RH-3FH series is shown in Fig. 5-2, and RH-6FH series is shown in Fig. 5-3.

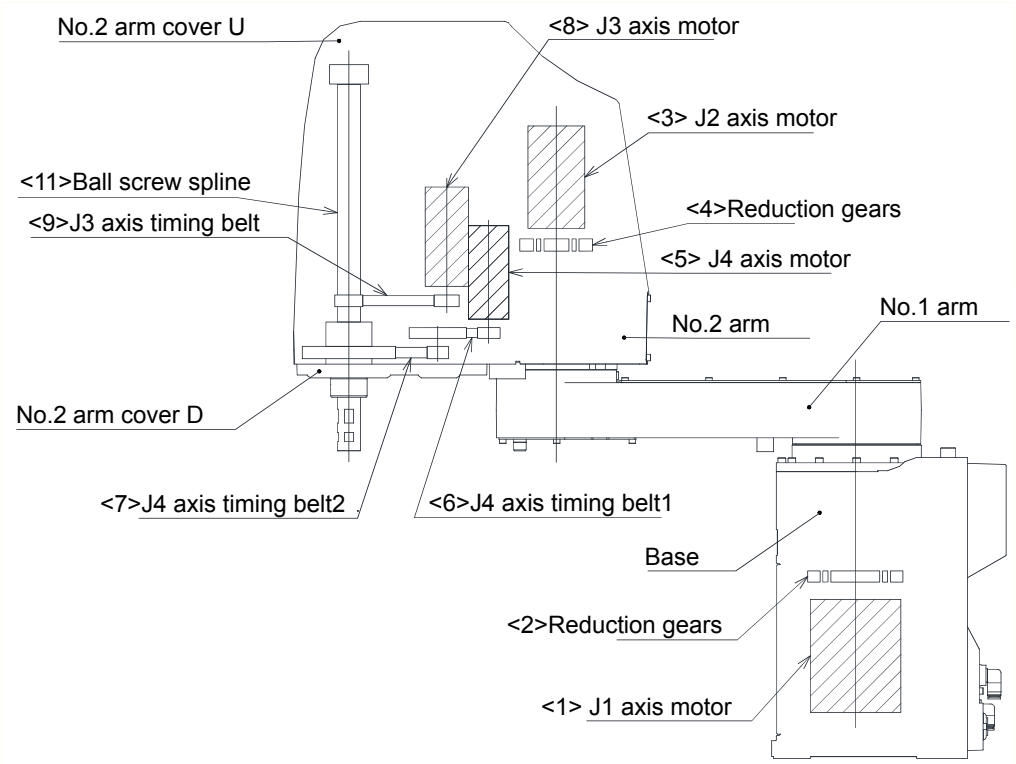


Fig.5-2 : Outline structure drawing of robot arm (RH-3FH)

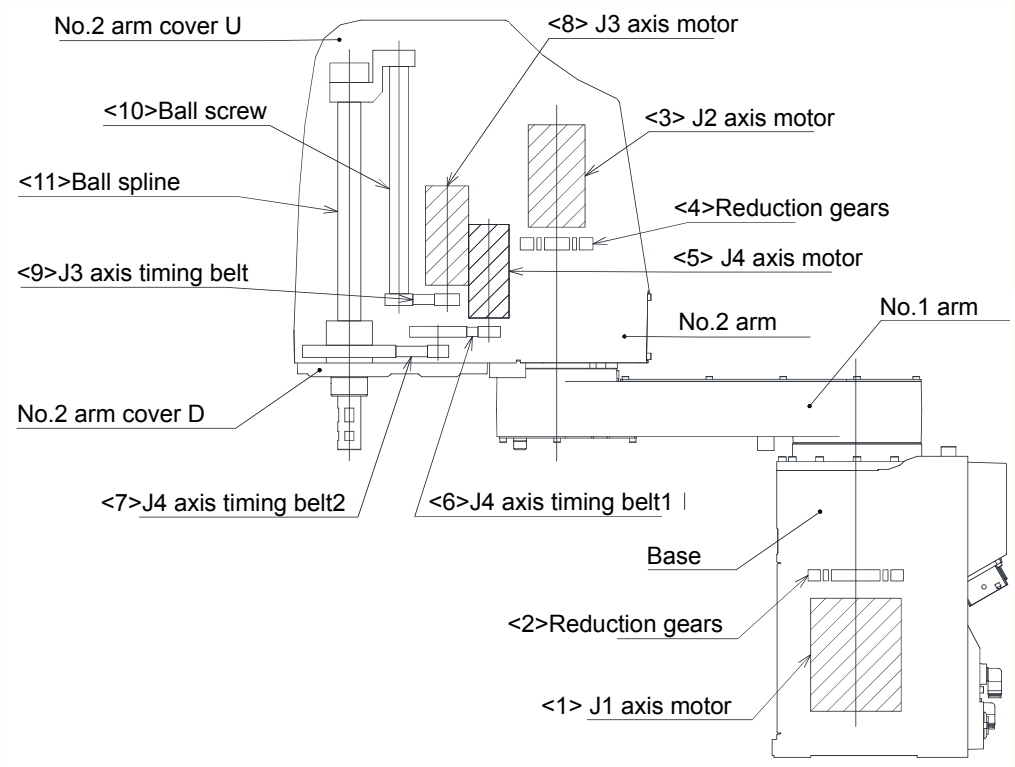


Fig.5-3 : Outline structure drawing of robot arm (RH-6FH)

5.3.2 Installing/removing the cover

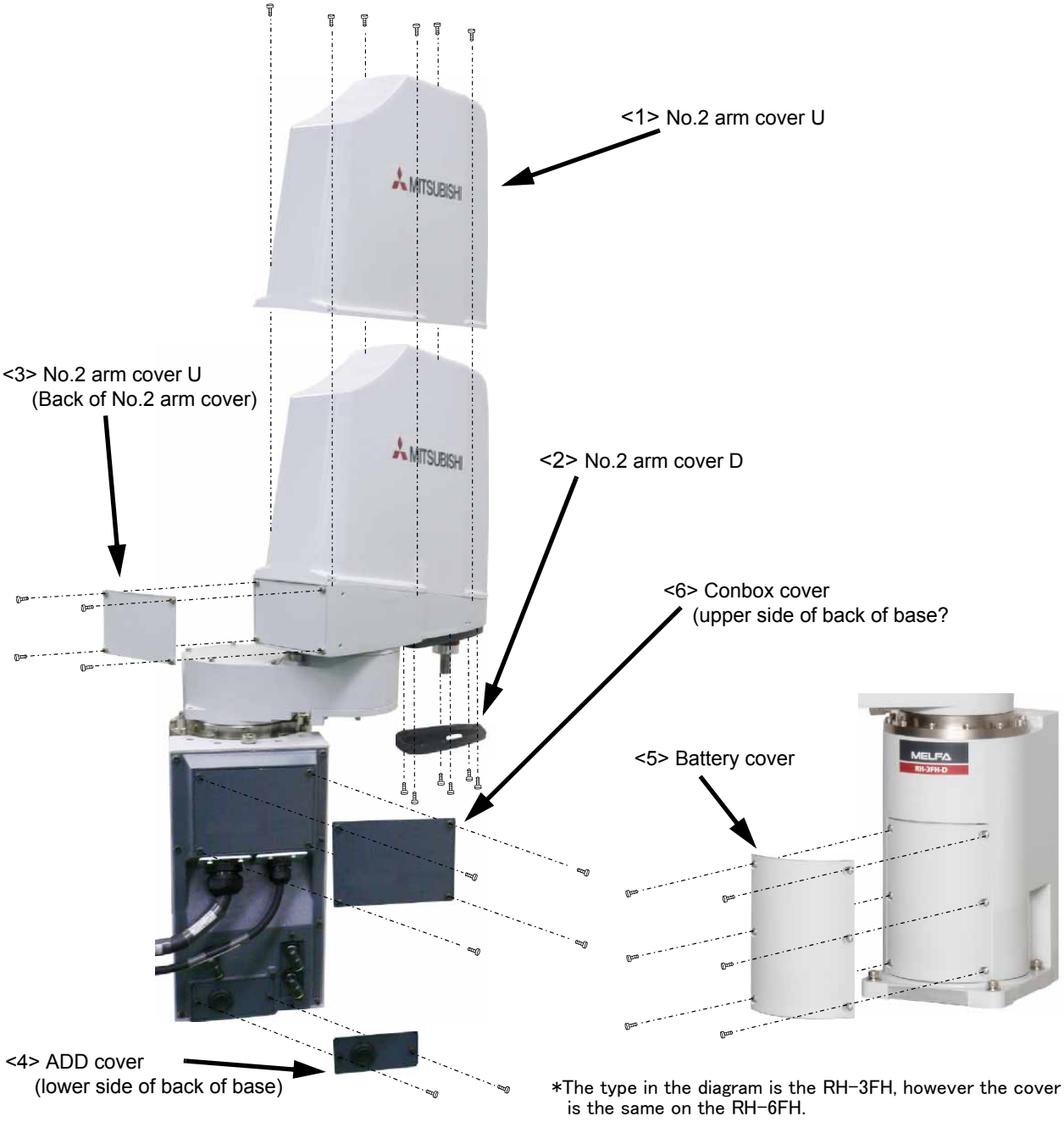

<1> No.2 arm cover U
<3> No.2 arm cover U
(Back of No.2 arm cover)
<2> No.2 arm cover D
<6> Conbox cover
(upper side of back of base?
<5> Battery cover
<4> ADD cover
(lower side of back of base)
*The type in the diagram is the RH-3FH, however the cover is the same on the RH-6FH.

Fig.5-4 : Installing/removing the cover

Note) This robot has packing. Refer to Page 87, "Table 5-7 : Consumable part list" for type name of packing.

⚠ CAUTION Check to see that the packing has not been torn or peeled off when the cover was mounted/removed. If it has been torn or peeled off, please contact dealer. If the cover is used with the packing torn or peeled off, oil mist and other substances may enter inside the arm and cause a malfunction.

Table 5-3 : Cover fixing screw list

No.	Cover name	Installation screw name: Qty.Note1)	Remarks
(1)	No.2 arm cover-U	Truss head screw, M4 x 10: 6	

No.	Cover name	Installation screw name: Qty.[Note1)]	Remarks
(2)	No.2 arm cover-D	Truss head screw, M4 x 10: 6	
(3)	No.2 arm cover-B	Hexagon socket bolts, M4 x 12: 4	
(4)	ADD cover	Hexagon socket bolts, M4 x 12: 2	
(5)	Battery cover	Truss head screw, M4 x 10: 6	
(6)	CONBOX cover	Hexagon socket bolts, M4 x 12: 4	

Note1)The fixing torque for each screw are 1.39-1.89Nm.

(1) Referring to Fig. 5-4, remove the covers.
(2) The names of the covers and installation screws are given in Table 5-3.
(3) When reattaching the covers after a maintenance inspection, proceed in the reverse order of their removal. Tightening the screw with the torque shown in Table 5-3.

[Note] Sealant is applied to the installation surface of cover in the oil mist and clean specification models. Be sure to replace the sealant if it has been dislocated and bent or crushed and does not return to its original shape. Moreover, in the case of oil mist and clean specification models, it is necessary to remove the bellows. Refer to Page 80, "5.3.5 Replacing the bellows" for details on how to remove bellows.

5.3.3 Packing Replacement Procedure

The packing gets deteriorated with the passage of time and must be replaced as required. Table 5-4 provides guidelines for replacing the packing. Replace the packing in accordance with the instructions given below. If the packing is not replaced in a timely manner, water or oil will be allowed to intrude the robot, possibly making it inoperative.

Table 5-4 : Packing replacement guideline

Service environment	Whether or not robot is pressurized	When packing must be replaced
General environment	Not pressurized Note1)	When signs of cracking or peeling are noted in the packing.
Clean room	Not pressurized Note1)	
Oil mist	Pressurized	
	Not pressurized	When the cover mounted on the robot is removed/put back in place

Note1) When used in the "general" or "clean room" environment, robot can do away with pressurization.

(1) Packing Replacement Instructions

Stick again new packing as before.

1) Remove the old packing, and clean and degrease the surface on which it has been placed.
2) The sticking surface of packing is double-coated adhesive tape. Referring to "Fig.5-5 : Example of sticking packing (good example)" and "Fig.5-7 : Sticking the cord-like packing", and stick the packing in line with form . Be careful for the packing not to slide. The example of unsuitable packing slid is shown in "Fig.5-6 : Example of sticking packing (bad example)".
3) Although the No.2 arm cover (U) sticks two or more packings per place, it has length with which packing ends overlap. Stick packing in the following procedures. For more information, see "Fig.5-8 : Examples of packing overlaps". Examples of improperly treated cut edge are shown, as well.
   a) Stick packing in line with form of the sticking surface. Finally, cut packing so that adjoining pieces have a 1mm overlap at the end.
   b) Apply liquid gasket to the cut edges. (Designated liquid gasket: 1212 (Maker: Three Bond))
   c) Stick so that the gap may not be made to each other's packing.

CAUTION Do not install the cover immediately after sticking packing. Install the cover, after the 6 hours pass after sticking packing for gasket hardening.

4) Confirm that packing is stuck correctly and install the cover. When tightening the bolts fixing the cover, avoid tightening them to a specified torque at a time. Tighten the bolt in the order shown as much as possible in the "Fig. 5-10: Example of order which tighten bolts." The torque which tightens the fixing bolt of each cover is shown in "Table 5-3 : Cover fixing screw list".

CAUTION Stick the packing securely, pressing down with the finger. If sticking is insufficient, when the cover is installed, packing slides by the pressure, and there is a possibility that it may become impossible to secure protection performance.

Completion of packing replacement

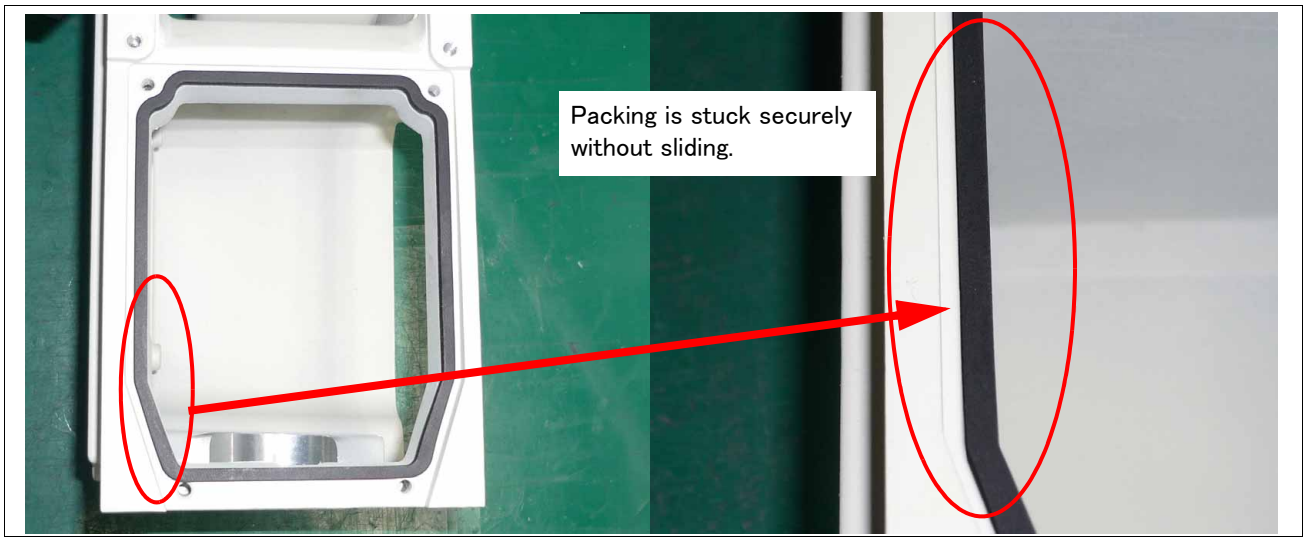


Fig.5-5 : Example of sticking packing (good example)

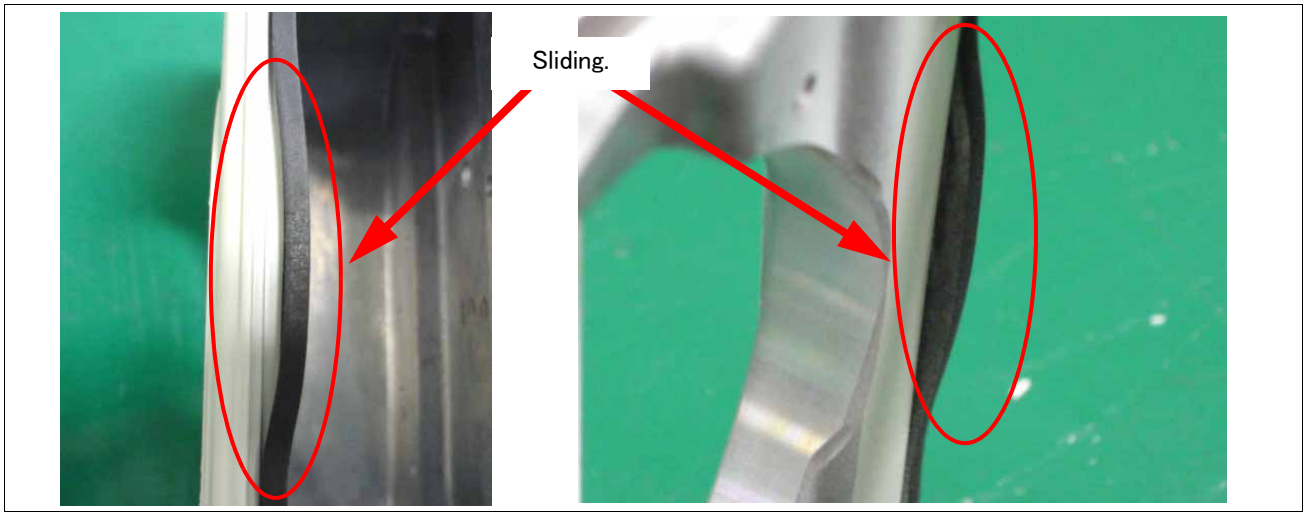


Fig.5-6 : Example of sticking packing (bad example)

Some of the packings to be used are cord-like.
Stick such packings by bending in line with the form.

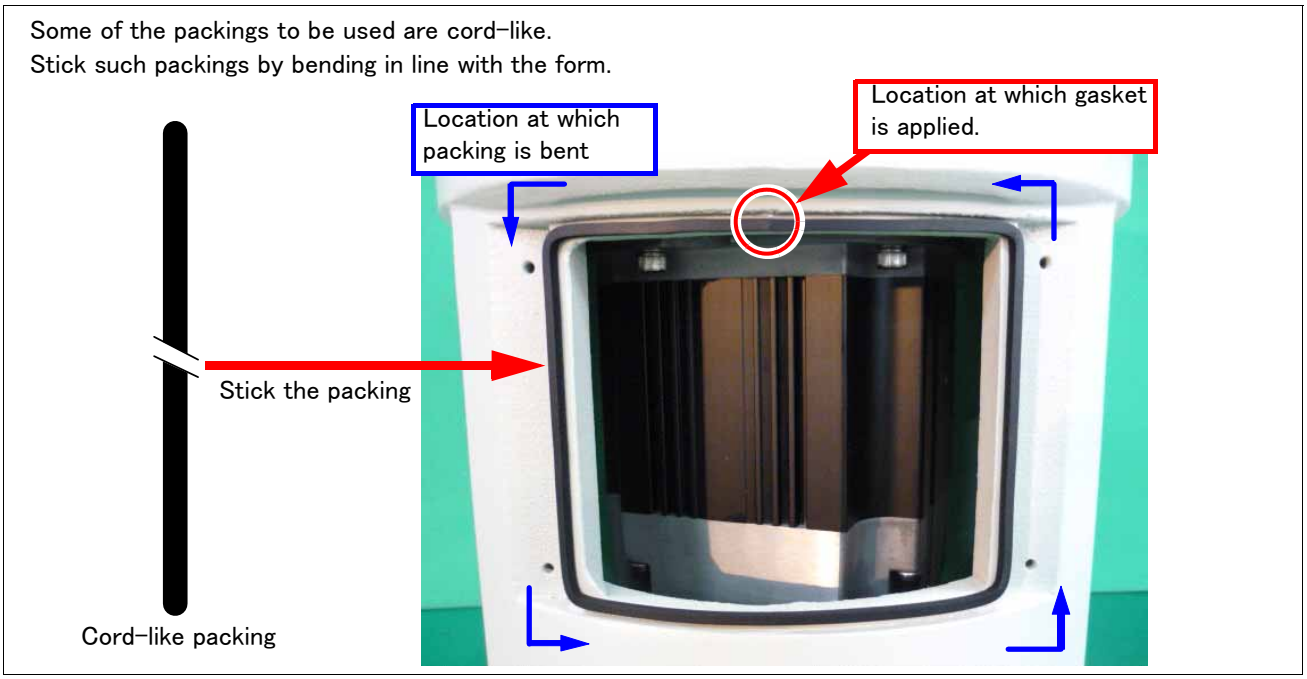
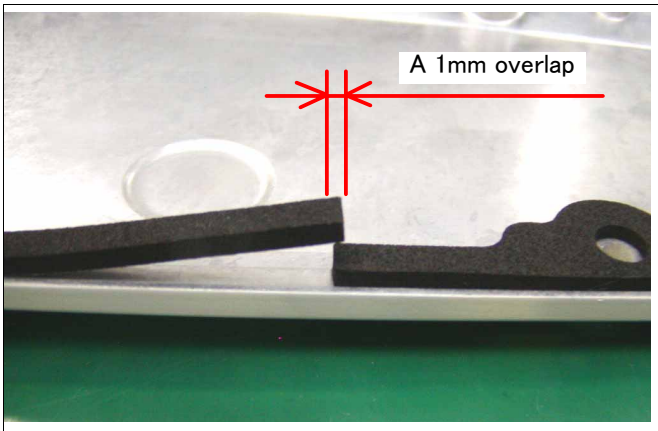
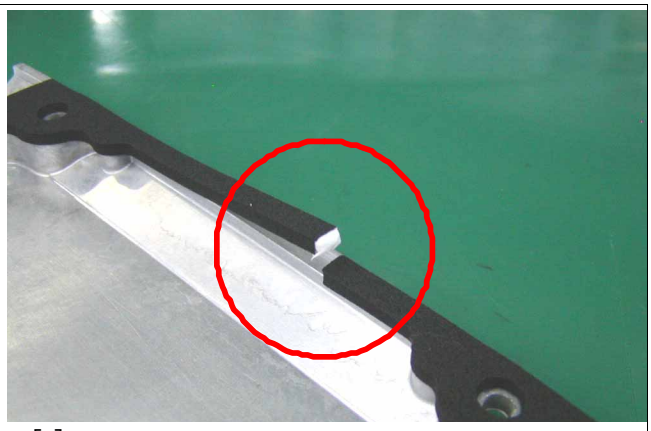


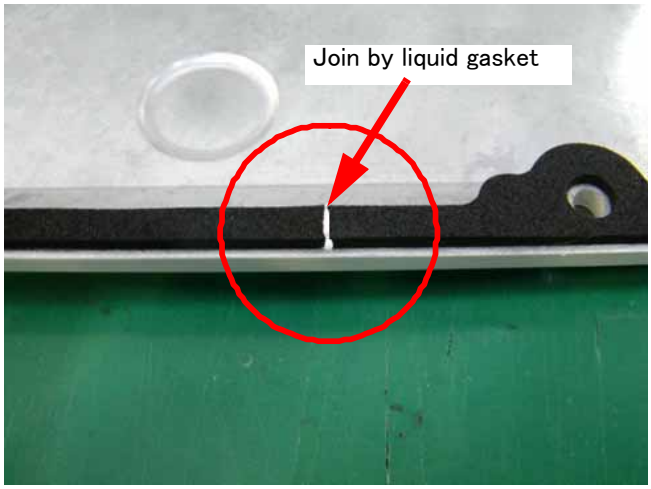
Fig.5-7 : Sticking the cord-like packing



[1] Cut the packing so that there is a 1mm overlap at the end.



[2] Apply liquid gasket to the cut edges.



[3] Stick the packing so that there is no gap between the adjacent pieces.

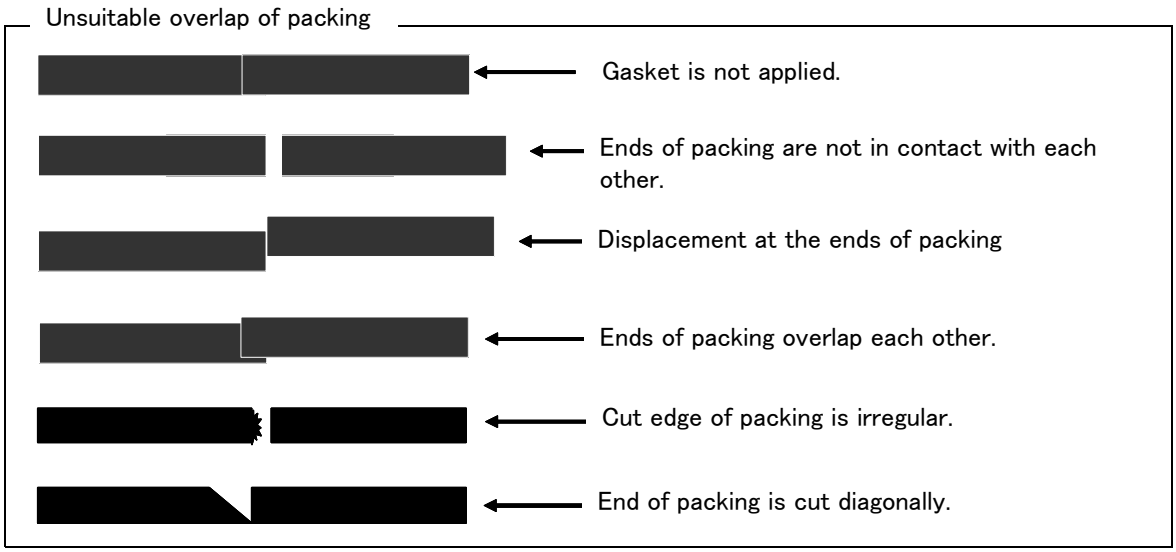

Unsuitable overlap of packing
Gasket is not applied.
Ends of packing are not in contact with each other.
Displacement at the ends of packing
Ends of packing overlap each other.
Cut edge of packing is irregular.
End of packing is cut diagonally.

Fig.5-8 : Examples of packing overlaps

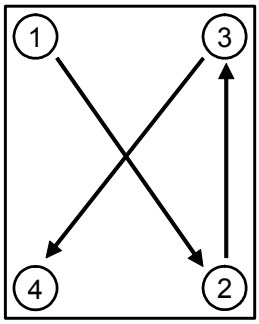


Fig.5-9 : Example of order which tighten bolts

5.3.4 Inspection, maintenance and replacement of timing belt

This robot uses a timing belt for the drive conveyance system of the J5 axis. Compared to gears and chains, the timing belt does not require lubrication and has a low noise. However, if the belt usage method and tension adjustment are inadequate, the life could drop and noise could be generated. Sufficient aging to remove the initial elongation of the belt, and adjustment of the belt tension have been carried out before shipment from the factory. However, depending on the robot working conditions, elongation will occur gradually over a long time. The tension must be confirmed during the periodic inspection. The timing belt must be replaced in the following cases.

In addition, it is serviceable if there is the sound wave type belt tension gauge in inspection and adjustment of the timing belt. The recommendation gauge is shown below. Please prepare by customer. Refer to the Page 79, "(7) Timing belt tension" for the tension adjustment value of the timing belt.

Maker:Gates Unitta Asia Company,
Type:U-505

Measurement by the sound wave type belt tension gauge

Measurement by the push-pull gauge

Fig.5-10 : Tension adjustment method of timing belt

(1) Timing belt replacement period

The timing belt life is greatly affected by the robot working conditions, so a set time cannot be given. However, if the following symptoms occur, replace the belt.

1) When cracks from at the base or back of the belt teeth.
2) When the belt expands due to adherence of oil, etc.
3) When the belt teeth wear (to approx. half of the tooth width).
4) When the belt teeth jump due to belt teeth wear.
5) When the belt snaps.

⚠ CAUTION Due to the manufacturing of the timing belt, initial wear will occur. Wear chips may accumulate in the cover after approx. 300 Hr of operating the robot, but this is not a fault. If the wear chips appear soon after wiping them off, replace the belt.

⚠ CAUTION When the belt is replaced, the machine system origin may deviate. In this case, the position data must be reviewed.

(2) RH-3FH series: Inspecting/Adjusting the J3 axis timing belt

The section related to J3 axis timing belt of RH-3FH series and adjustment is shown in Fig. 5-11. The picture is the image which removed the No.2 arm cover.

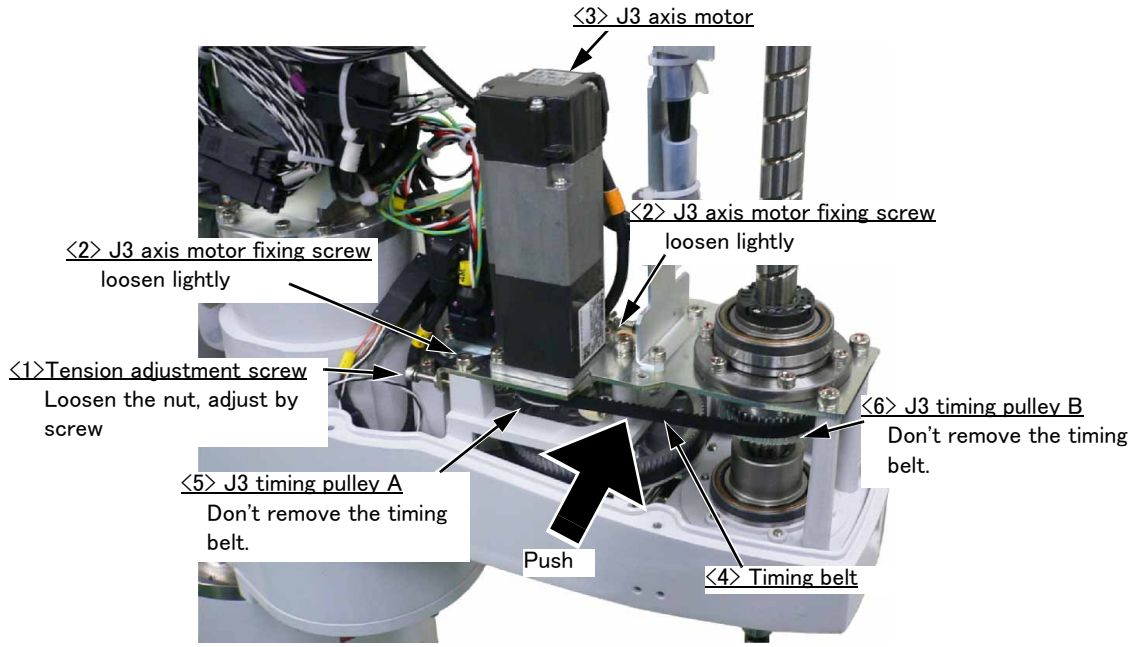


Fig.5-11 : Inspecting/Adjusting the J3 axis timing belt

Inspection and adjustment procedure of the timing belt of J3 axis are shown below.

1) Confirm that the power supply of the controller is OFF.
2) Refer to Page 62 "Fig. 5-4Installing/removing the cover", and remove the No.2 arm cover U.
3) Visually confirm that the symptoms indicated in"(1)Timing belt replacement period" have not occurred with the <4> timing belt.
4) Lightly press the center of the belt, and confirm that the value of belt slack is in following. The tension of the belt is shown also in Page 79 "Fig. 5-14Belt tension".
   ・Belt tensioning: Force to press = approx. 2N, Flexure = 1.5mm

When adjustment is necessary, continue to follow the procedure shown below.
When adjustment is not necessary, install the No.2 arm cover U as before and finish the inspection.

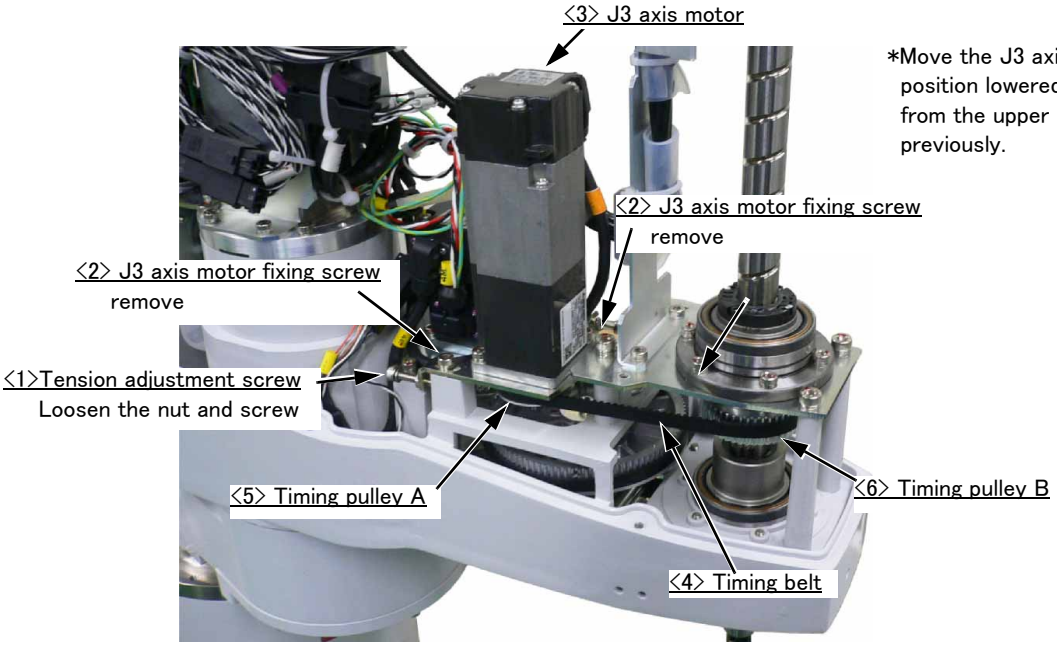
5) Lightly loosen J3 motor installation screws <2> (Be careful not to overly loosen the screws.).
6) The nut which is fixing tension adjustment screw <1> is loosened, turn tension adjustment screw <1>, and adjust the tension of timing belt <4>.
   When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
   Adjust tension to the above-mentioned value.
   Note) Be careful, if the belt is removed from pulley <5> <6>, or the mesh of belt and pulley <5> <6> is shifted by loosening the screw too much, the origin will deviate. If the position deviated, reset the origin. (Refer to Page 88, "5.6 Resetting the origin")
7) After adjustment, fasten securely the two J3 axial motor fixing screws <2>, and the nut of tension adjustment screw <1>.
8) Improper tightening may cause the belt to loosen with vibration.
9) Install No.2 arm cover U securely as before and finish adjustment.

This completes adjustment of the J3 axis timing belt.

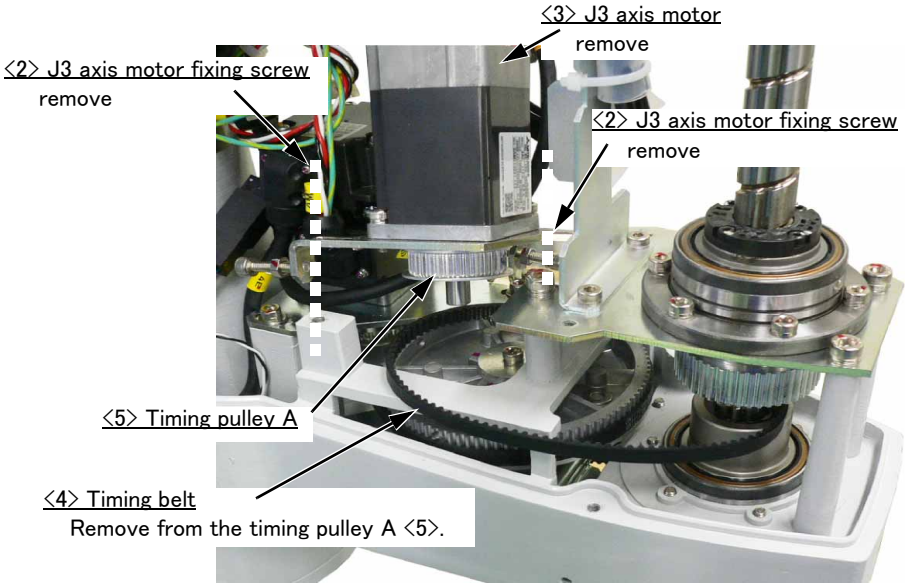
(3) RH-3FH series: Replacing the J3 axis timing belt

The procedure for replacing the J3 axis timing belt on the RH-3FH series is shown below. The diagram shows an image of the removed No. 2 arm cover U.
After replacing the J3 axis timing belt the resetting the origin of J3 and J4 axis is necessary.

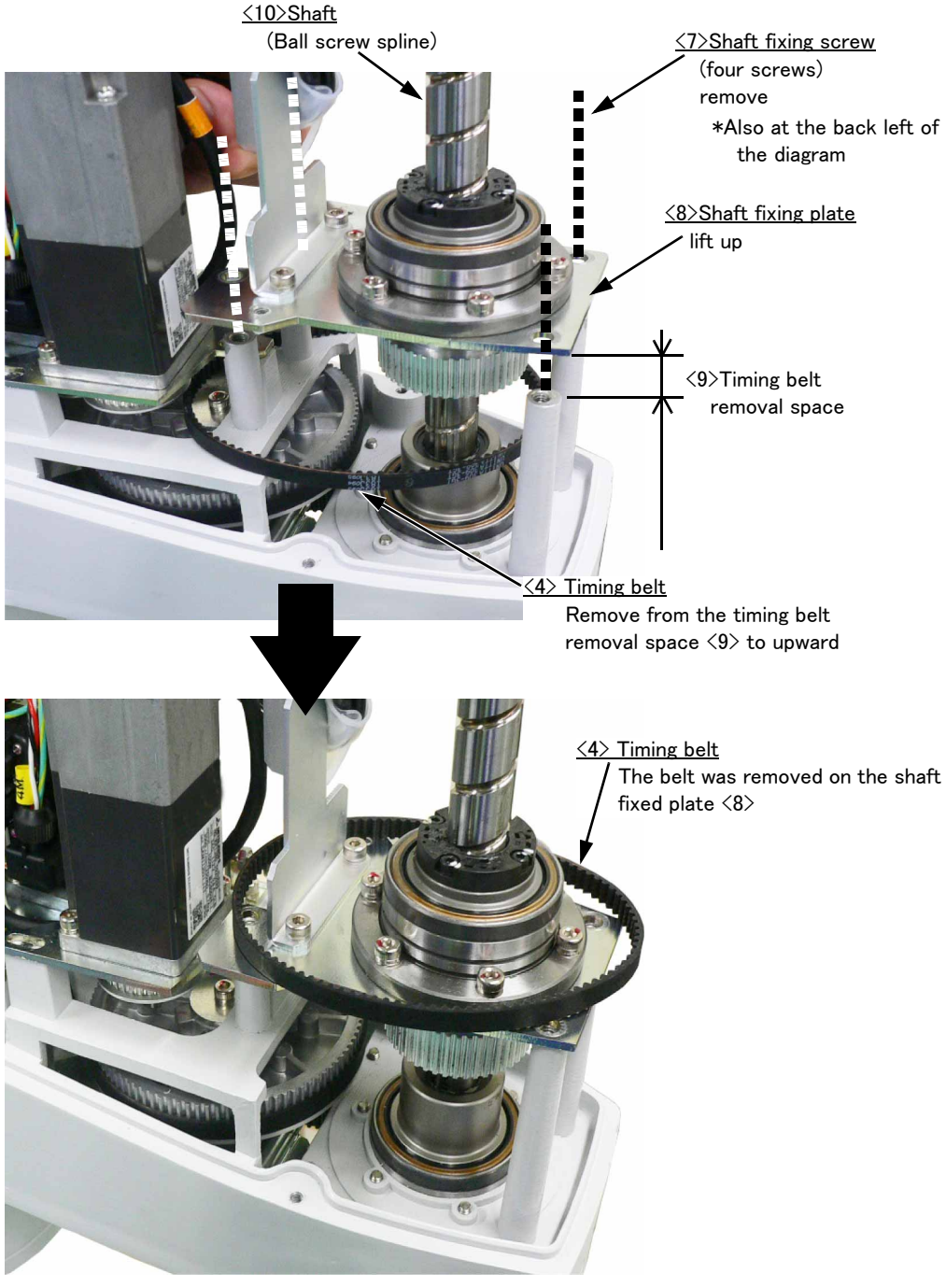
1) Move the J3 axis to the position lowered about 30mm from the upper limit by jog operation. This position makes the space for removing the belt.
   After moving the J3 axis turn the controller's power supply OFF.
2) Refer to Page 62 "Fig. 5-4Installing/removing the cover", and remove the No.2 arm cover U.
3) Loosen the nut of tension adjustment screw <1>, and loosen the tension adjustment screw <1>.


<3> J3 axis motor
*Move the J3 axis to the position lowered about 30mm from the upper limit previously.
<2> J3 axis motor fixing screw
remove
<2> J3 axis motor fixing screw
remove
<1>Tension adjustment screw
Loosen the nut and screw
<5> Timing pulley A
<6> Timing pulley B
<4> Timing belt

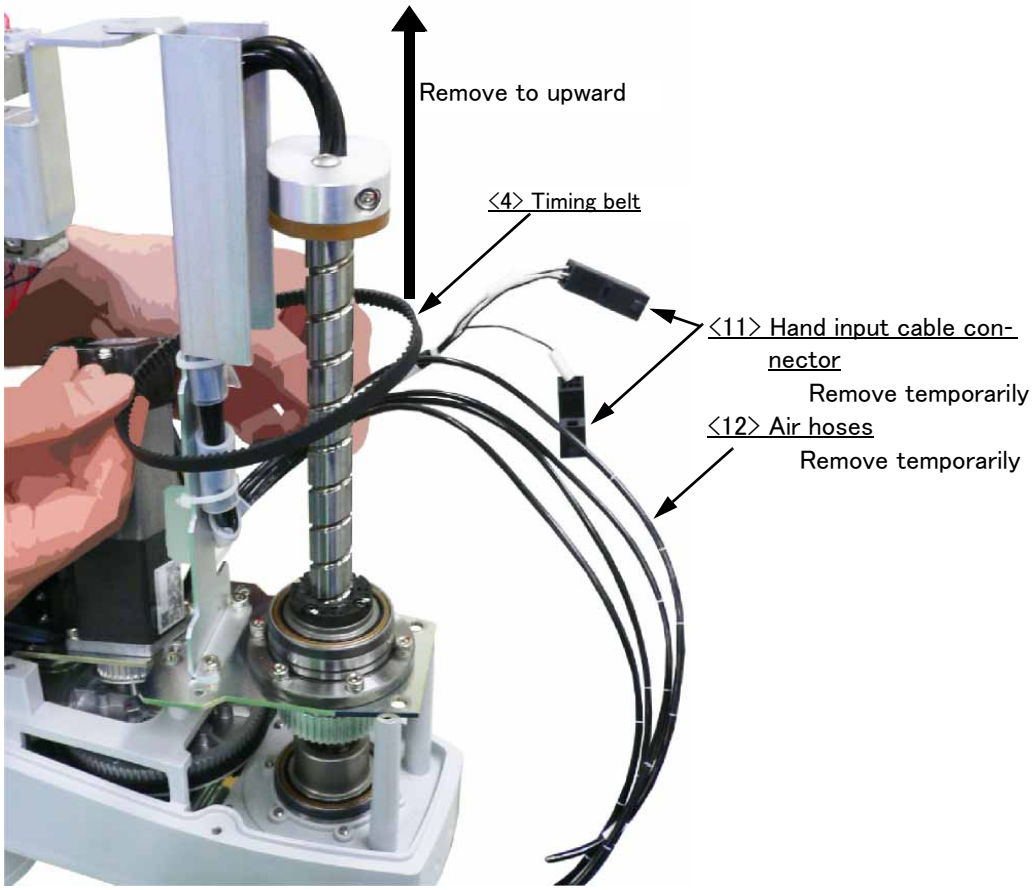
4) Remove two fixing screws <2>, remove the J3 axis motor <3>, remove the timing belt <4> from the timing pulley A <5>.



5) Remove the timing belt <4> from the shaft to upward.
Remove the fixing screw <7> of shaft fixing plates and lift up the shaft fixing plate <8>.
When using the optional hand internal wiring and piping set remove the fixing screws fixed to the top.
Remove the timing belt <4> from the timing belt removal space <9> created under the shaft fixing plate <8> by lift up.



6) Remove the timing belt <4> from the top of the shaft
If using the optional hand internal wiring and piping set, temporarily remove the hand input cable connector <11> and air hoses <12> of solenoid valve side. And remove the timing belt to upward.



7) Install the new timing belt in reverse procedure of removal.
Install the new belt to the timing pulley (on the motor) <5> and timing pulley B <6> securely.
Fix the shaft fixing plate <8> by fastening the original fixing screws securely.
If using the hand input cables <11> and air hoses <12>, connect them as before.
8) Install the J3 axis motor <3> by tightening lightly the J3 axis motor fixing screw <2> (two screws)
9) Adjust the tension of J3 axis timing belt with referring to Page 69, "(2) RH-3FH series: Inspecting/Adjusting the J3 axis timing belt".
10) Install No.2 arm cover U securely as before.
11) Reset the origin of J3 and J4 axis with referring to the Page 88, "5.6 Resetting the origin"
12) When the maintenance forecast function is valid, reset the accumulation data about the belt. Reset by the dedicated screen or parameter MFBRST of RT ToolBox2.
13) Refer to "Instruction Manual/RT ToolBox2 User's Manual" for operation of RT2 and refer to "Instruction Manual/Detailed Explanation of Functions and Operations" for the parameter.

This completes replacement of the J3 axis timing belt.

(4) RH-6FH series: Inspecting/Adjusting the J3 axis timing belt

The section related to J3 axis timing belt is shown in Fig. 5-12. The picture is the image which removed the No.2 arm cover.

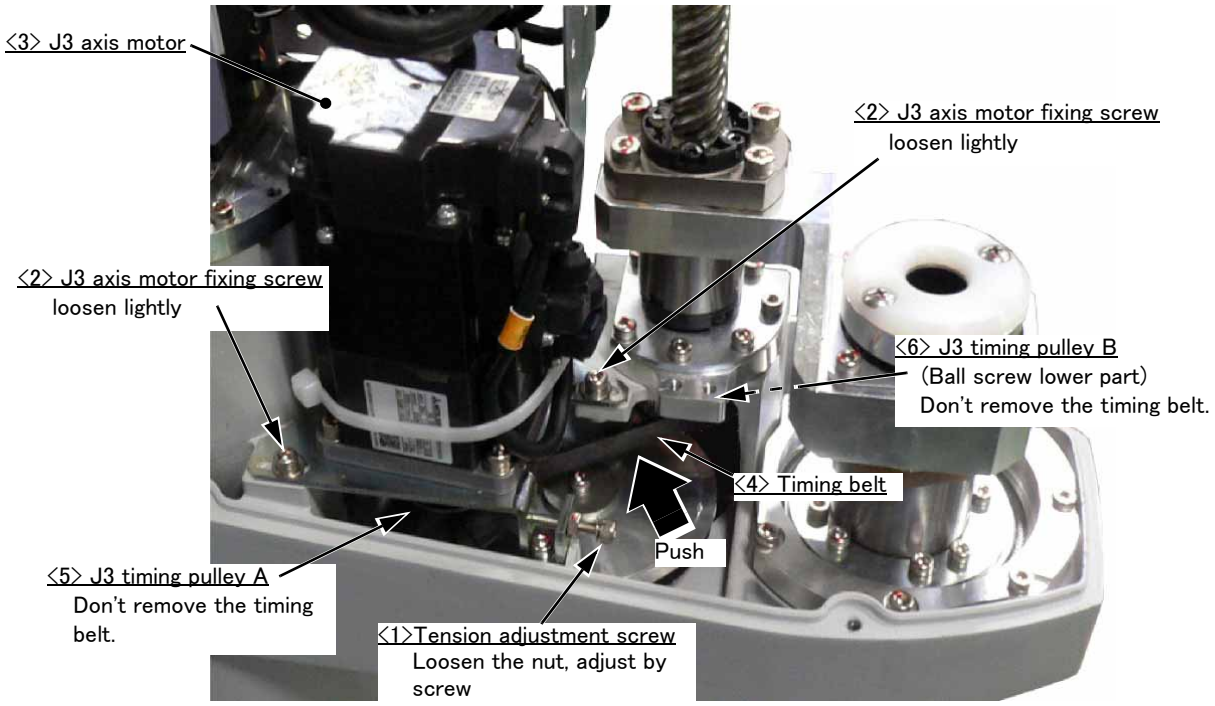


Fig.5-12 : Inspecting/Adjusting the J3 axis timing belt

Inspection and adjustment procedure of the timing belt of J3 axis are shown below.

1) Confirm that the power supply of the controller is OFF.
2) Refer to Page 62 "Fig. 5-4Installing/removing the cover", and remove the No.2 arm cover U.
3) Visually confirm that the symptoms indicated in 「"(1)Timing belt replacement period" have not occurred with the <4> timing belt.
4) Lightly press the center of the belt, and confirm that the value of belt slack is in following. The tension of the belt is shown also in Page 79 "Fig. 5-14Belt tension".
   ・Belt tensioning: Force to press = approx. 3N, Flexure = 1.3mm

When adjustment is necessary, continue to follow the procedure shown below.
When adjustment is not necessary, install the No.2 arm cover U as before and finish the inspection.

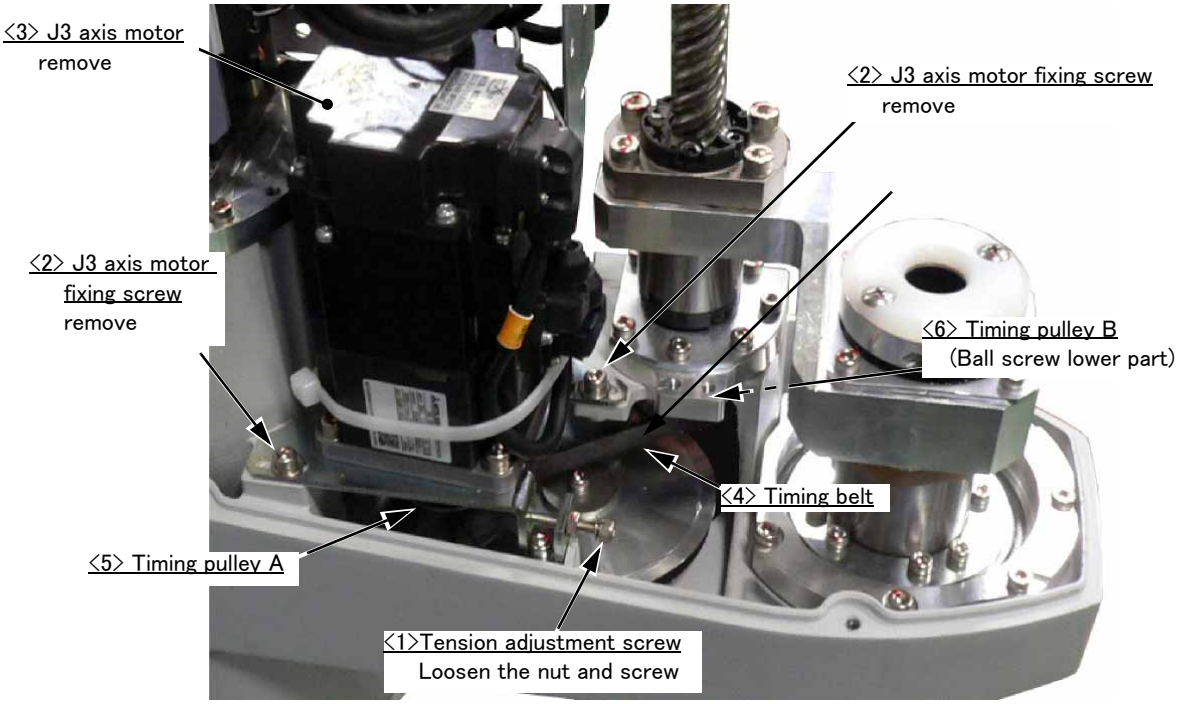
5) Lightly loosen J3 motor installation screws <2> (Be careful not to overly loosen the screws.).
6) Loosen the tension adjustment screw <1>. Adjusts by turning the tension adjustment screw <1> slowly and moving the J3 axis motor <3> little by little.
   When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
   Adjust tension to the above-mentioned value.
   Note) Be careful, if the belt is removed from pulley <5> <6>, or the mesh of belt and pulley <5> <6> is shifted by loosening the screw too much, the origin will deviate. If the position deviated, reset the origin. (Refer to Page 88, "5.6 Resetting the origin")
7) After adjustment, fasten securely the two J3 axial motor fixing screws <2>, and the nut of tension adjustment screw <1>. Improper tightening may cause the belt to loosen with vibration.
8) Install No.2 arm cover U securely as before and finish adjustment.

This completes adjustment of the J3 axis timing belt.

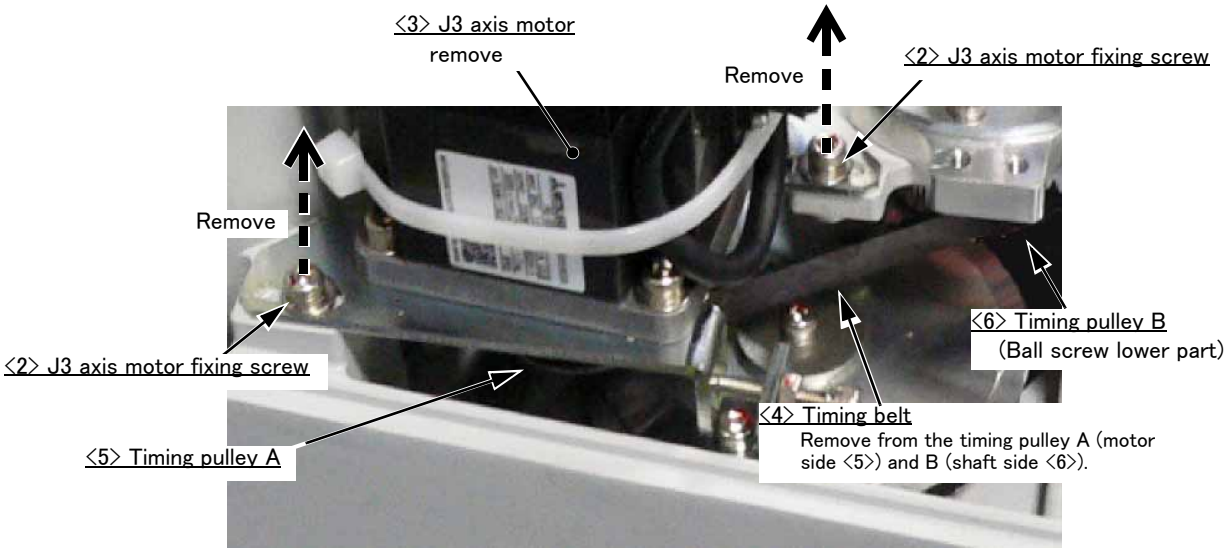
(5) RH-6FH series: Replacing the J3 axis timing belt

The procedure for replacing the J3 axis timing belt on the RH-6FH series is shown below. The diagram shows an image of the removed No. 2 arm cover U.
After replacing the J3 axis timing belt the resetting the origin of J3 and J4 axis is necessary.

1) Refer to Page 62 "Fig. 5-4Installing/removing the cover", and remove the No.2 arm cover U.
2) Loosen the nut of tension adjustment screw <1>, and loosen the tension adjustment screw <1>.



3) Remove two fixing screws <2>, and remove the J3 axis motor <3>.



4) Remove the timing belt <4> from the timing pulley A (motor side <5>) and B (shaft side <6>).
5) Install surely the new belt to the timing pulley (on the motor) <5> and timing pulley B <6>, and fix the J3 axis motor <3> with J3 axis motor fixing screw <2>.
Confirms having related the timing belt <4> to the timing pulley A <5> and the timing pulley B <6> securely.
6) Adjust the tension of J3 axis timing belt with referring to Page 73, "(4) RH-6FH series: Inspecting/Adjusting the J3 axis timing belt".
7) Install No.2 arm cover U securely as before.
8) Reset the origin of J3 and J4 axis with referring to the Page 88, "5.6 Resetting the origin"

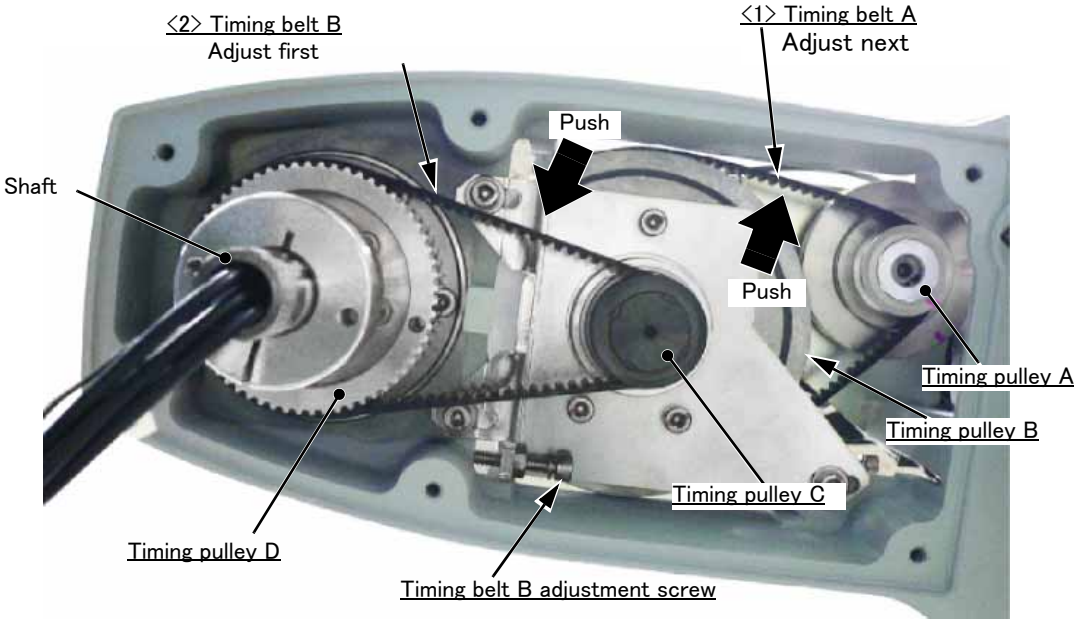
9) When the maintenance forecast function is valid, reset the accumulation data about the belt. Reset by the dedicated screen or parameter MFBRST of RT ToolBox2. Refer to "Instruction Manual/RT ToolBox2 User's Manual" for operation of RT2 and refer to "Instruction Manual/Detailed Explanation of Functions and Operations" for the parameter.

This completes replacement of the J3 axis timing belt.

(6) RH-3FH/RH-6FH series: Inspecting/Adjusting the J4 axis timing belt

As shown in Fig. 5-13, the J4 axis timing belt consists of two timing belts: timing belt A <1> and timing belt B <2>. When adjusting the timing belts, first adjust timing belt B <2> and then proceed to adjust timing belt A <1>.

<The No.2 arm bottom view (Inside of the No.2 arm cover D)>



<The No.2 arm upper view (Inside of the No.2 arm cover U)>

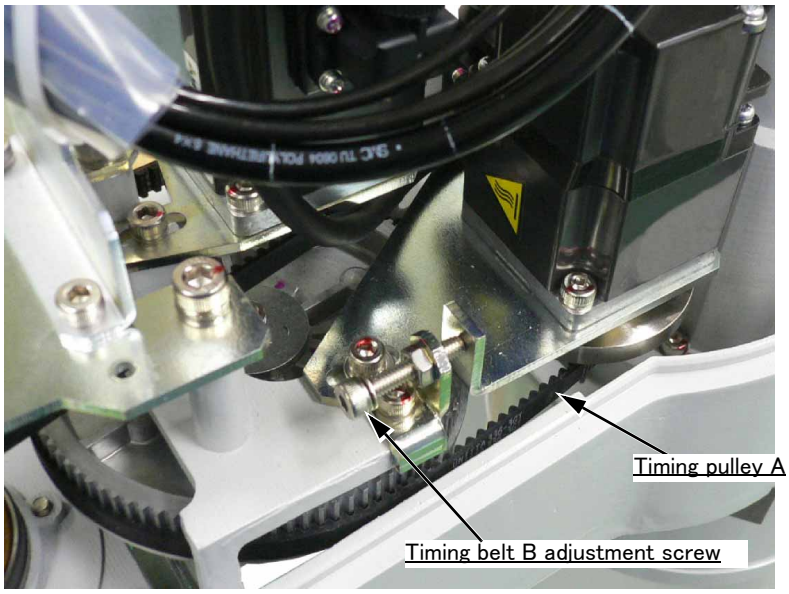


Fig.5-13 : Inspecting/Adjusting the J4 axis timing belt

Inspection and adjustment procedure of the timing belt of J4 axis are shown below.

1) Confirm that the power supply of the controller is OFF.
2) Refer to Page 62 "Fig. 5-4Installing/removing the cover", and remove the No.2 arm cover U and No.2 cover D.
3) Visually confirm that the symptoms indicated in"(1)Timing belt replacement period" have not occurred with the timing belt.
4) Lightly press the center of the belt, and confirm that the value of belt slack is in following. The tension of the belt is shown also in Page 79 "Fig. 5-14Belt tension".

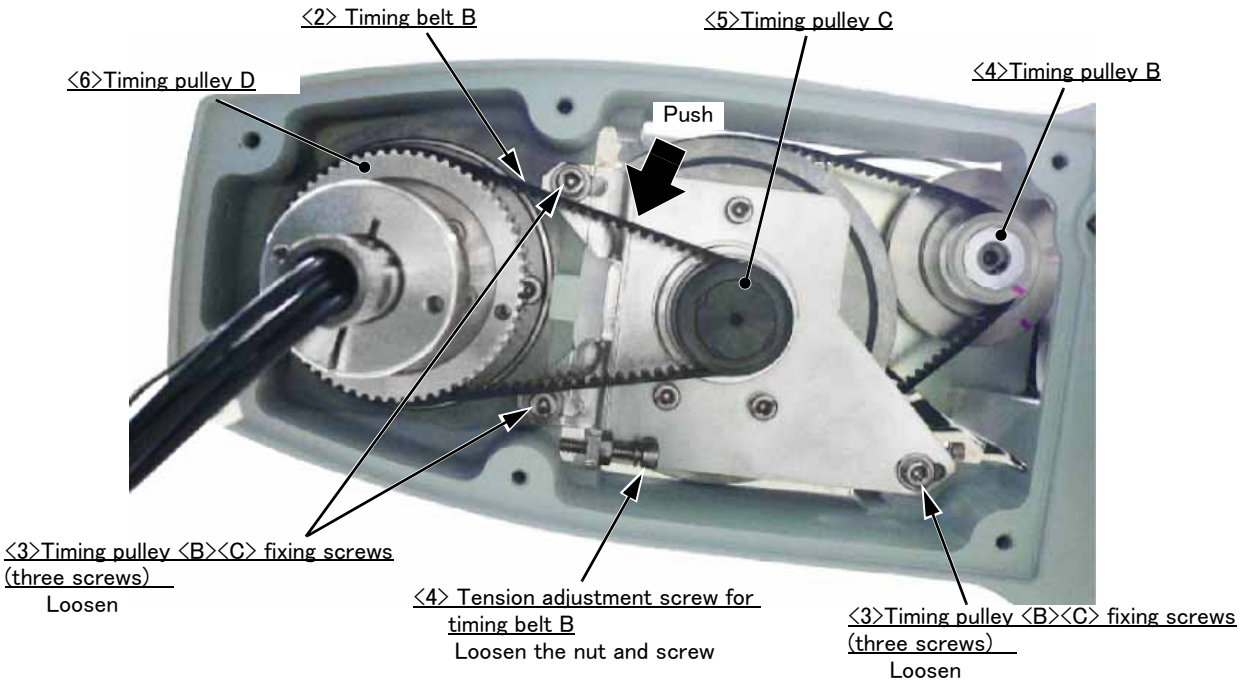
Belt tensioning

- RH-3FH..... <1>Timing belt A: Force to press = approx. 2N, Flexure = 1.0mm
  <2>Timing belt B: Force to press = approx. 4N, Flexure = 1.2mm
- RH-6FH..... <1>Timing belt A: Force to press = approx. 2N, Flexure = 1.0mm
  <2>Timing belt B: Force to press = approx. 4N, Flexure = 1.5mm

When adjustment is necessary, continue to follow the procedure shown below.
When adjustment is not necessary, install the No.2 arm cover U and No.2 arm cover D as before and finish the inspection.

5) Adjusts the tension of the timing belt B <2>.
   Lightly loosen timing pulley <B><C> fixing screws <3> (Be careful not to overly loosen the screws.).
6) Loosen the nut of tension adjustment screw <4> for timing belt B. Adjusts by turning the tension adjustment screw <4> slowly and moving the timing pulley C <5> little by little.
   When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
   Adjust tension to the above-mentioned value.
   Note) Be careful, if the belt is removed from pulley <5> <6>, or the mesh of belt and pulley <5> <6> is shifted by loosening the screw too much, the origin will deviate. If the position deviated, reset the origin. (Refer to Page 88, "5.6 Resetting the origin")

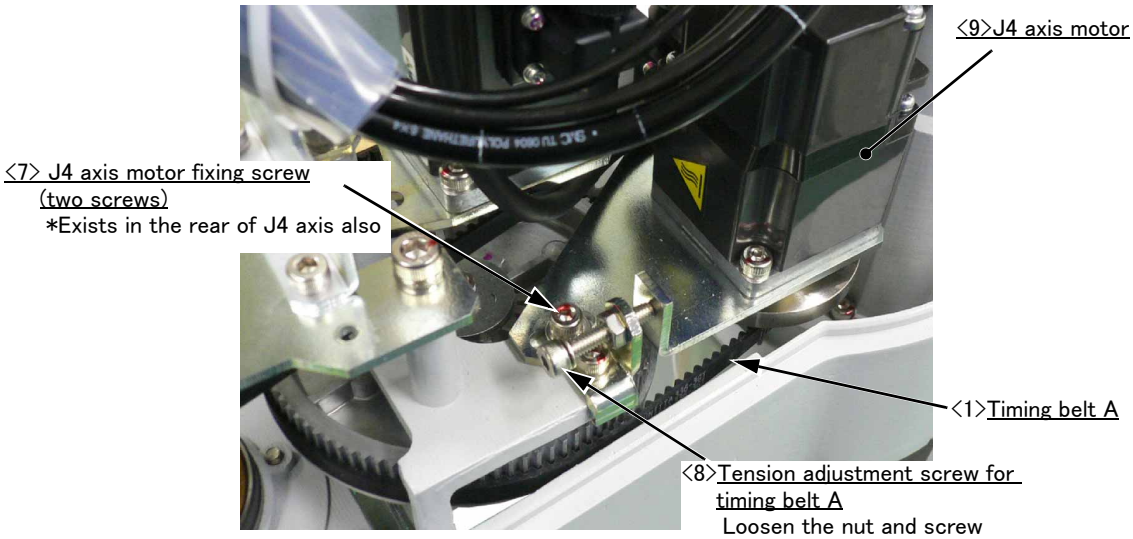
<The No.2 arm bottom view (Inside of the No.2 arm cover D)>



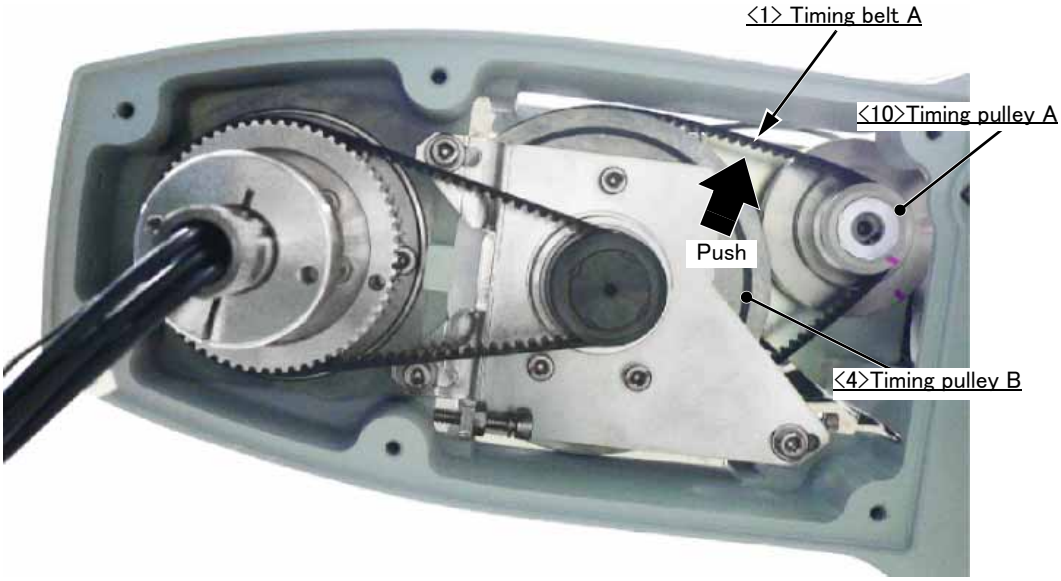
7) After adjustment, fasten certainly the three timing pulley <B><C> fixing screws <3>. And fasten certainly the nut of tension adjustment screw <4>.
8) Improper tightening may cause the belt to loosen with vibration.

9) Next, adjusts the tension of the timing belt A <1>.
Lightly loosen two J4 motor fixing screws <7> (Be careful not to overly loosen the screws.).
10) Loosen the nut of tension adjustment screw <8> for timing belt A. Adjusts by turning the tension adjustment screw <8> slowly and moving the J4 axis motor <9> little by little.
When the screw is turned to the right, the belt will be stretched, and when turned to the left, will loosen.
Adjust tension to the above-mentioned value.
Note) Be careful, if the belt is removed from pulley <10> <4>, or the mesh of belt and pulley <10> <4> is shifted by loosening the screw too much, the origin will deviate. If the position deviated, reset the origin. (Refer to Page 88, "5.6 Resetting the origin")

<The No.2 arm upper view (Inside of the No.2 arm cover U)>


<9>J4 axis motor
<7> J4 axis motor fixing screw
(two screws)
*Exists in the rear of J4 axis also
<1>Timing belt A
<8>Tension adjustment screw for timing belt A
Loosen the nut and screw

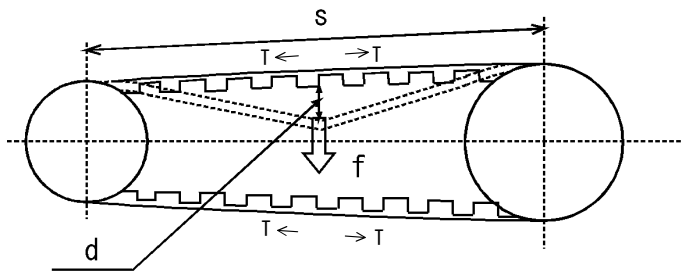
<The No.2 arm bottom view (Inside of the No.2 arm cover D)>



11) After adjustment, fasten certainly the two J4 motor fixing fixing screws <7> And fasten certainly the nut of tension adjustment screw <8>. Improper tightening may cause the belt to loosen with vibration.
12) Install No.2 arm cover U and No.2 arm cover D securely as before and finish adjustment.

This completes adjustment of the J4 axis timing belt.

(7) Timing belt tension



f : Pressing force
s : Span
d : Slack
T : Tension

Pressing force

Axis	Belt type	Span : s (mm)	Slack : d (mm)	Pressing force : f (N)	Remarks
RH-3FH series					
J3	309-3GT-6	96	1.5	2	
J4(motor side)	336-3GT-6	64	1.0	2	
J4(shaft side)	282-3GT-12	74	1.2	4	
RH-6FH series					
J3	264-3GT-6	82	1.3	3	
J4(motor side)	315-3GT-6	64	1.0	2	
J4(shaft side)	363-3GT-12	95	1.5	4	

The preset value and adjustment value in the sound wave type belt tension gauge

Axis	Belt type	Preset value			Standard tension T(N)
		M(g/m)	W(mm/R)	S(mm)	
RH-3FH series					
J3	309-3GT-6	2.5	6	96	26-32
J4(motor side)	336-3GT-6	2.5	6	64	26-32
J4(shaft side)	282-3GT-12	2.5	12	74	53-65
RH-6FH series					
J3	264-3GT-6	2.5	9.0	82	40-48
J4(motor side)	315-3GT-6	2.5	6.0	64	26-32
J4(shaft side)	363-3GT-12	2.5	12.0	95	53-65

Note) The value given in the table is the value of proper tension. Because the tension declines by the infancy expansion when exchanged to please adjust proper tension again after the operation for the about 100 hours when exchanged to new belt

Fig.5-14 : Belt tension

The timing belt can satisfactorily convey the drive and keep a durable force only when it has an adequate tension. The belt tension should not be too tight or too lose. Instead, it should be adjusted to a degree that elasticity is felt when the belt is pressed with the thumb. If the belt tension is too weak, the belt loosening side will vibrate. On the other hand, if the belt tension is too strong, a sharp sound will be heard and the belt tension side will vibrate.
The detailed adjustment (tension) is shown in Fig. 5-14.
Check and adjust with the belt pressing force f and the slack amount d between span s.

5.3.5 Replacing the bellows

With reference to Fig. 5-16, exchanges the bellows. Replace method of bellows is shown below.

⚠ CAUTION Replace the bellows in a place where there is no risk of contamination by dust and oil mist. If it must be replaced in a dust-filled area, be sure to remove as much dust as possible in advance before replacing it.

(1) Clean specification

1) Turn off the controller's power supply.
2) Refer to Page 62, "5.3.2 Installing/removing the cover", and remove the No.2 arm cover U and the No.2 arm cover D.
3) Loosen the two fixing (M4) screws of bellows, and remove the bellows to downward together with No.2 arm cover D.
4) Remove the four fixing screws which fix the bellows to the No.2 arm cover D, and removes the ring, then the bellows can be removed from No.2 arm cover D.
5) Fix the new bellows to the No. 2 arm cover D in the same way (screw tightening torque: 0.8Nm). Fill the gap between the No. 2 arm cover D and the bellows with a seal such as a liquid gasket.
6) Install the No. 2 arm cover D as before.
7) Fix the bellows to shaft with adjusting the position of the bellows's bottom to 30mm from end of shaft. Align two set screws (M4) to the D cut surface and fix them securely.
8) Fill the gap between the bellows fixing section and the shaft with a seal, such as a liquid gasket.
9) Sticks the attached ABS mark on the lower part of bellows. Makes the J4 axis into the position of 0 degree by jog operation etc., and match the ABS mark sticker with ABS mark on the shaft, and stick it.

This completes the replacing bellows.

[Caution] When installing the No. 2 arm cover D to the No. 2 arm, please check the condition of the sealing. If the sealing material has been removed or has been bent or broken, and it is not suitable to be reused, be sure to replace the sealing material.

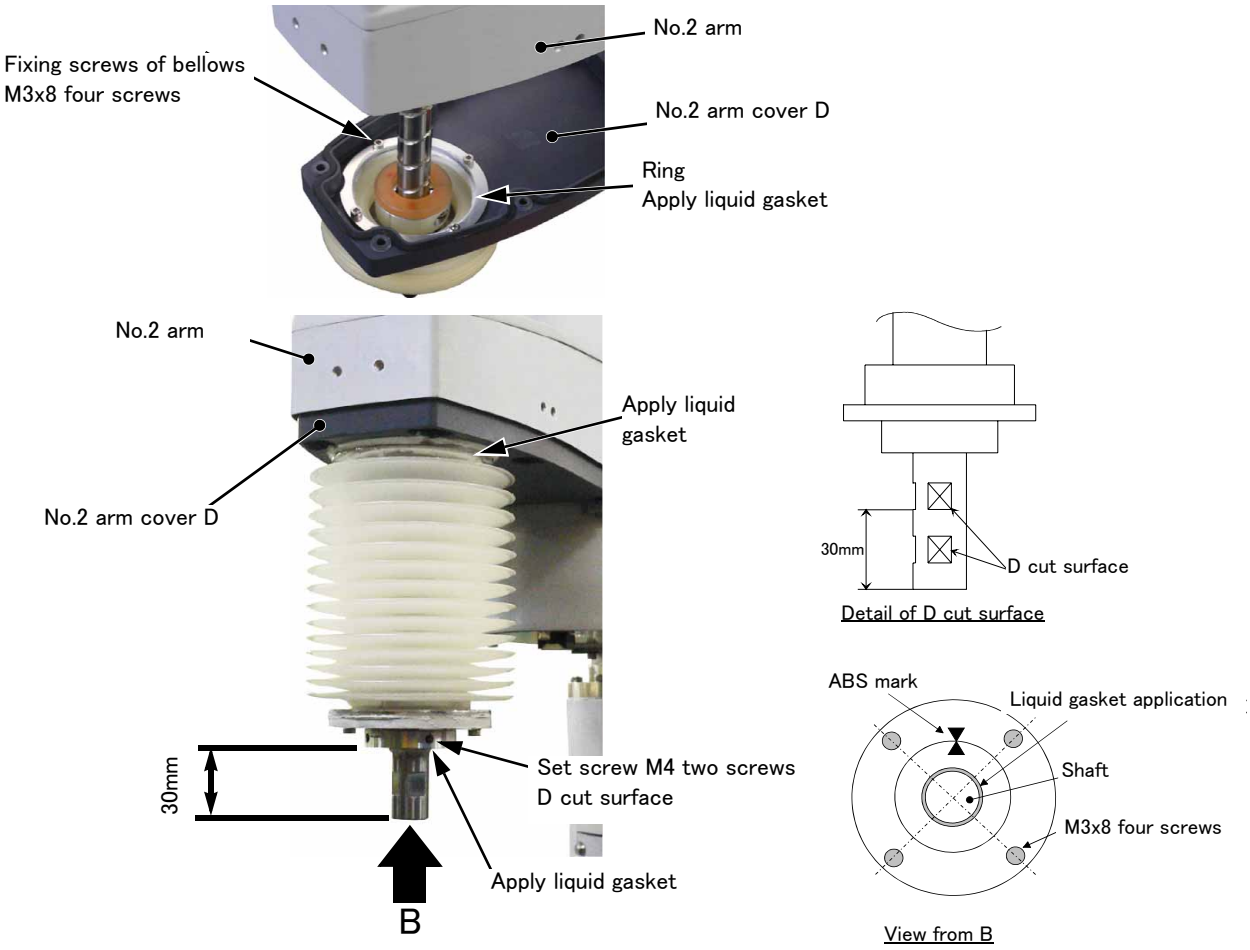


Fig.5-15 : Replace the bellows (clean specification)

(2) Oil mist specification

1) Previously, move the J3 axis to upper end position by jog operation.
   This position is necessary to set the ABS mark (marking-off line) of J4 axis after.
2) Turn off the controller's power supply.
3) Remove the four screws (M3x8) which fix the lower part of bellows to the frange.
4) Lift the bellows, and loosen the two set screws of the frange, and remove the frange.
5) Loosens the fixing screw of the bellows stop ring which is fixing the upper part of bellows, and remove bellows.
6) Installs new bellows.
7) Installs the frange in the position of 30 mm from the shaft lower end as before. Align two set screws (M4) to the D cut surface and fix them securely.
8) Fixes the bellows lower part to the frange as before. Fixes the four bellows fixing screws (M3x8) securely.
9) Makes the J4 axis into the position of 0 degree by jog operation etc., and match the ABS mark (marking-off line) with ABS mark (marking-off line) on the shaft.
   In the condition that each other's ABS mark has matched, fixes the bellows upper part.
10) Fixes the fixing screw of the bellows stop ring as before, and fixes the upper part of bellows securely.

⚠ CAUTION The fixing screw should fix the bellows stop ring in the position used as the inner side. (refer to figure) If that is not right, the fixing screw may interfere with the No.1 arm. And, you should confirm that the stop ring has covered the perimeter of bellows surely. If the fixation is not enough, the protection performance may drop.

This completes the replacing bellows.

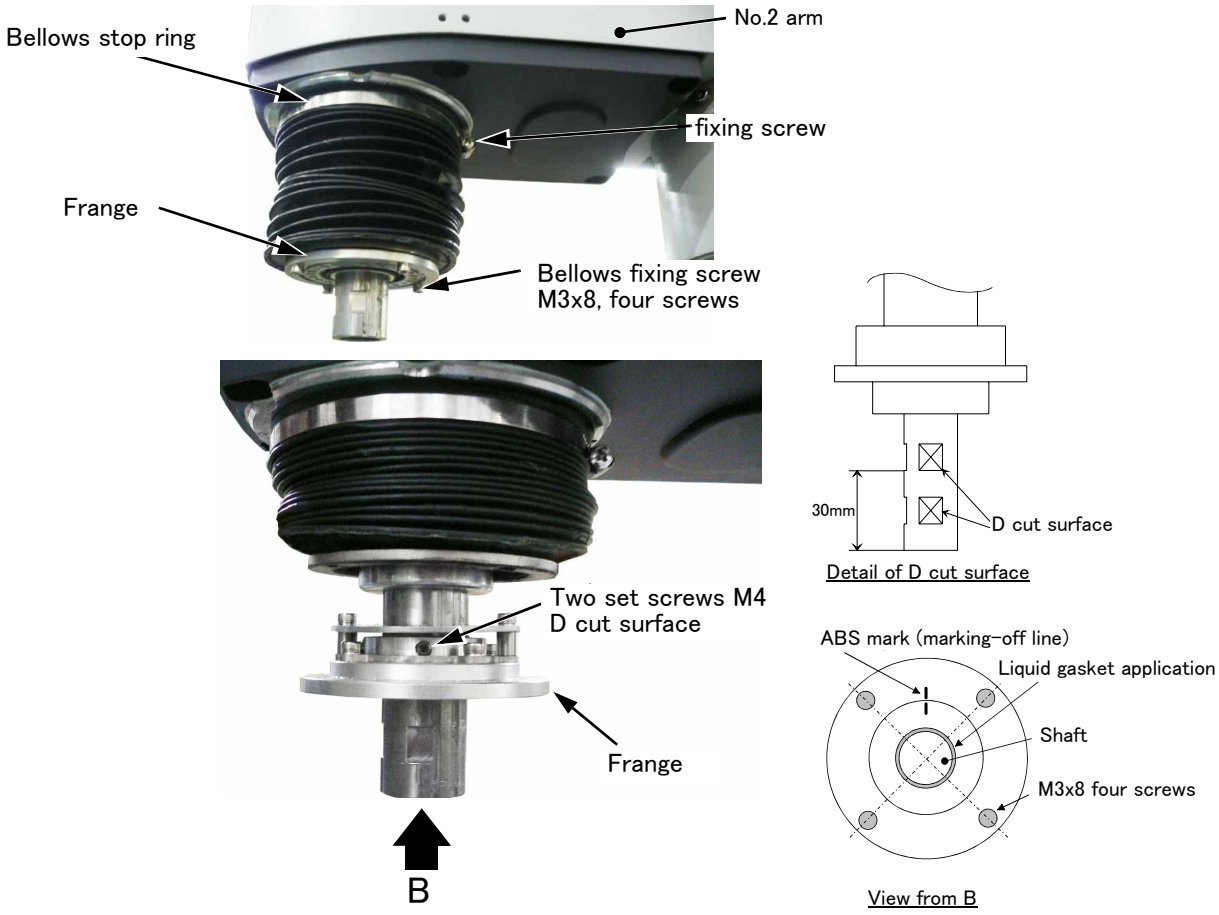


Fig.5-16 : Replace the bellows (oil mist specification)

5.3.6 Lubrication

(1) Lubrication position and specifications

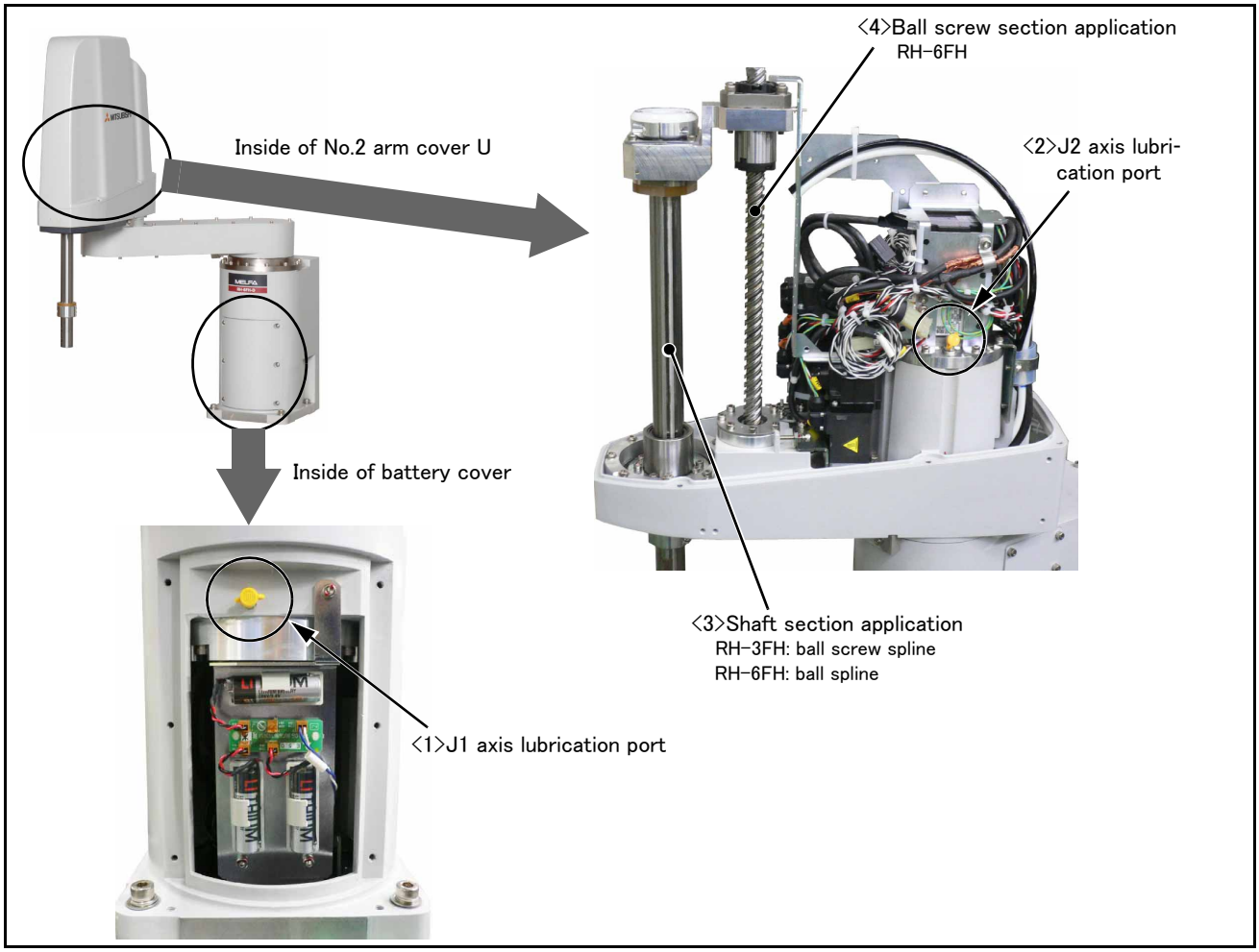


Fig.5-17 : Lubrication positions

Table 5-5 : Lubrication specifications

No.	Parts to be lubricated	Lubrication method	Lubrication oil Default charge amount (maker)	Lubrication interval	Lubrication amount guide	Cover to remove
RH-3FH series						
<1>	J1 axis reduction gears	Grease nipple WC-610(Only addition)	4BNo2 (Harmonic Drive Systems Inc.)	24,000 Hr	12 g	Battery cover
<2>	J2 axis reduction gears			24,000 Hr	8 g	No.2 arm cover U
<3>	Shaft (ball screw spline)	Wipe the old grease, and applies	Multemp PS2 (KYODO YUSHI CO., LTD.)	Every 2,000km movement	1 g	
RH-6FH series						
<1>	J1 axis reduction gears	Grease nipple WC-610(Only addition)	4BNo2 (Harmonic Drive Systems Inc.)	24,000 Hr	12 g	Battery cover
<2>	J2 axis reduction gears			24,000 Hr	8 g	No.2 arm cover U
<3>	Shaft (ball spline)	Wipe the old grease, and applies	Multemp PS2 (KYODO YUSHI CO., LTD.)	Every 2,000km movement	1 g	
<4>	Shaft (ball screw)				1 g	

The grease nipple position is shown in Fig. 5-17. The lubrication specifications for each place are shown in Table 5-5. When lubricating, remove the covers that need to be taken off by refer to "Fig.5-4 : Installing/removing the cover".

[Caution]
- The brands of grease given in Table 5-5 are those filled when the robot is shipped.
- The lubrication time is a cumulative value of the operation at the maximum speed. If the operation has been suspended, or if the designated speed is slow, the lubrication time can be lengthened in proportion.
- Depending on the robot operation state, the lubrication time will fluctuate, so determine the time according to the state so that the grease does not run out.
- The numbers in the Table 5-5 correspond to the supply positions in Fig. 5-17.

(2) Lubrication method to the J1, J2 axis

1) Turn off the controller's power supply.
2) Refer to the "Fig.5-4 : Installing/removing the cover" and remove the covers.
3) Insert the grease shown in Table 5-5 using a grease gun from the lubrication grease nipple. Add only the specified amount of grease. Adding excess grease may cause grease to leak.

⚠ CAUTION Use manual grease gun, and inject grease with pressure 0.03Mpa or less. Do not use the grease gun, which derived by the factory air presser to avoid injecting by too high pressure.
Recommendation grease gun: KH35 (Yamada Corporation Inc.,)

4) Install the removed cover as before.
   Note) Sealant is applied to the installation surface of cover in the oil mist and clean specification models. Be sure to replace the sealant if it has been dislocated and bent or crushed and does not return to its original shape.
5) When the maintenance forecast function is valid, reset the accumulation data about the belt. Reset by the dedicated screen or parameter MFGRST of RT ToolBox2. Refer to "Instruction Manual/RT ToolBox2 User's Manual" for operation of RT2 and refer to "Instruction Manual/Detailed Explanation of Functions and Operations" for the parameter.

This complete of lubricating to J1, J2 axis.

(3) Lubrication method to the shaft

1) Applies the grease only above the shaft only. Move the J3 axis to upper limit using the jog operation
2) Refer to Page 62 "Fig. 5-4Installing/removing the cover", remove the No. 2 arm cover-U. The bellows must be removed in the case of the oil mist and clean specifications. Reference Page 80, "5.3.5 Replacing the bellows"and remove the bellows.

⚠ CAUTION Replace the bellows in a place where there is no risk of contamination by dust and oil mist. If it must be replaced in a dust-filled area, be sure to remove as much dust as possible in advance before replacing it.

3) Wipe the old grease off the ball spline or ball screw. Wipe off the grease inside the No. 2 arm cover-U and the bracket attached vertically to the shaft fixing area.
4) Apply the specified amount of grease to the ball spline and ball screws. If too much grease is applied, grease can spread inside the No. 2 arm, and if it reaches to the timing belt, can cause the timing belt to deteriorate quicker than usual.
5) Install the No.2 arm cover as before. Install the bellows as before in the oil mist and clean specification
   Note) Sealant is applied to the installation surface of cover in the oil mist and clean specification models. Be sure to replace the sealant if it has been dislocated and bent or crushed and does not return to its original shape.

This completes of applying grease to shaft.

5.3.7 Replacing the backup battery

An absolute encoder is used for the position detector, so while power of controller is turned off the position must be saved by the backup battery. The controller also uses a backup battery to save the program, etc. The battery is the lithium battery. These batteries are installed when the robot is shipped from the factory, but as these are consumable parts, they must be replaced periodically by the customer.

The guideline for replacing the battery is one year, but this will differ according to the robot's usage state. There exists the kinds of the errors about the battery shown in Table 5-6. If error 7500 occurs, please exchange the battery of the robot arm and the controller simultaneously.

Table 5-6 : The error about the battery

Item	Error number	Description	Measure
Controller	7520	The battery consumption time was exceeded	Replace the battery
	7510	Battery voltage low	
	7500	No battery voltage	The backup data cannot be guaranteed if this error occurs.
Robot arm	7520	The battery consumption time was exceeded	Replace the battery
	133n[Note1)]	Encoder battery voltage low。	
	112n	Encoder ABS position data lost	The backup data cannot be guaranteed if this error occurs.

Note1) "n" indicates the axis number

The method of replacing the battery of robot arm is shown below.
refer to the separate "Instruction manual/Controller setup, basic operation, and maintenance" about controller's battery.
About the purchase of the battery, refers to Page 87, "5.5 Maintenance parts".

⚠ CAUTION If error 7500 or 112n occurs, the program data and other data in the controller is lost and it becomes necessary to load the data such as program and origin data again.

(1) Replacing the battery (robot arm)

⚠ CAUTION The power supply for the encoder is supplied by cable connected with battery board. The cable must be connected while replacing the battery or operating usually. Thus, if the cable connection is incomplete, the encoder position data will be lost, and resetting the origin is necessary.

⚠ CAUTION Replace the battery one by one . If all batterys are removed the encoder data will be lost, and resetting the origin is necessary.

The battery installation position is shown in Fig. 5-18. Refers to the figure and replaces the batteries in the following procedures.

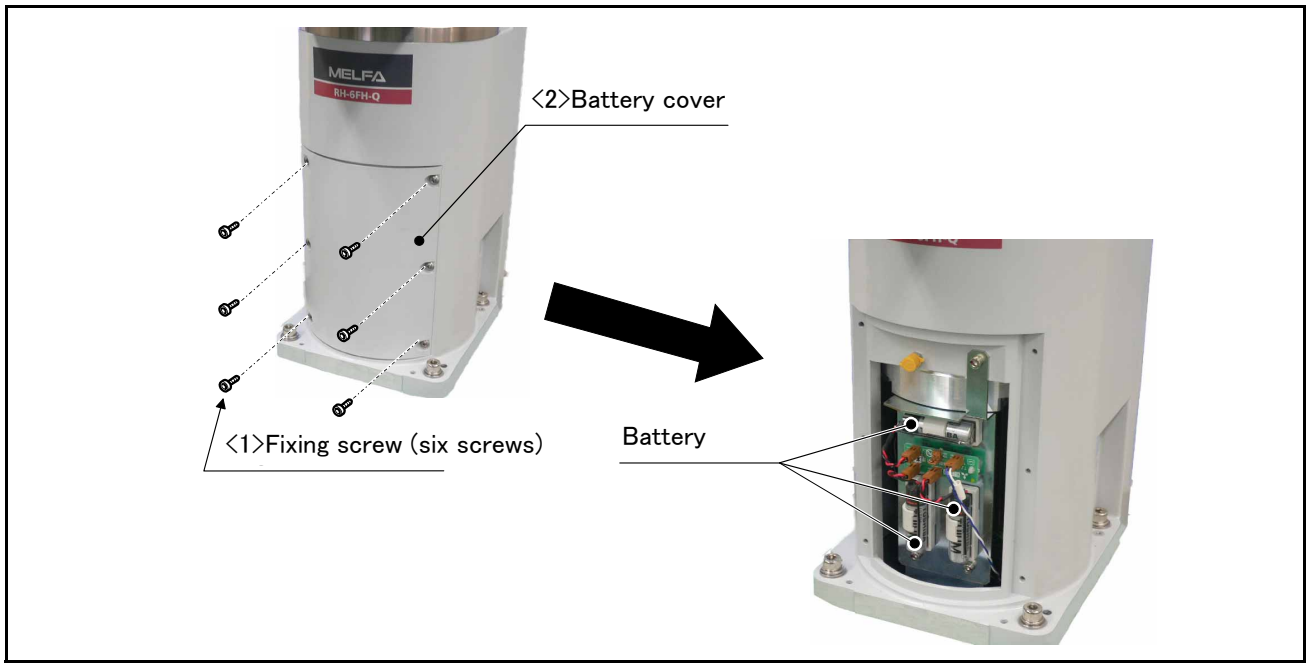


Fig.5-18 : Replacing the battery

1) Turn the controller control power OFF.
2) Remove the six fixing screws <1>, and remove the battery cover <2>.
3) Replace the battery one by one. Remove the old battery from the holder, and disconnect the lead connector.
4) Insert the new battery into the holder, and connect the lead connector. Replace all batteries with new ones at the same time.
   All the batteries should check that it has been exchanged newly. If the old battery is contained, generating heat and damaging may occur.
5) Install the battery cover <2> as before. Be careful so that the cable may not be inserted.
6) Initialize the battery consumption time.
   Always carry out this step after replacing the battery, and initialize the battery usage time. Refer to the separate "Instruction Manual/Detailed Explanation of Functions and Operations" for details on the operation methods.

[Note] If the reason for replacement is power down of the battery, resetting the origin is necessary. (refet to xxx)

5.4 About Overhaul

Robots which have been in operation for an extended period of time can suffer from wear and other forms of deterioration. In regard to such robots, we define overhaul as an operation to replace parts running out of specified service life or other parts which have been damaged, so that the robots may be put back in shape for continued use. Overhaul interval for robots presumably varies with their operating conditions and thus with the degree of the equipment's wear and loss of performance. As a rule of thumb, however, it is recommended that overhaul be carried out before the total amount of servo-on time reaches the predetermined levels (24,000 hours for the robot body and 36,000 hours for the controller). (See Fig. 5-19.) For specific information about parts to be replaced and timing of overhaul, contact your local service representative.

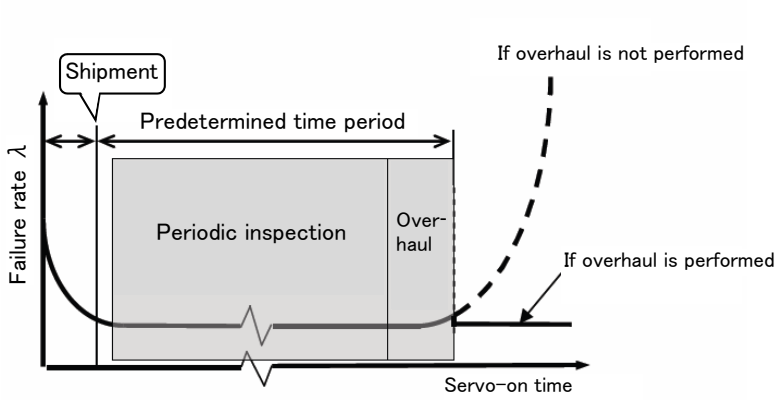


Fig.5-19 : Periodic inspection/overhaul periods

5.5 Maintenance parts

The consumable parts that must be replaced periodically are shown in Table 5-7, and spare parts that may be required during repairs are shown in Table 5-8. Purchase these parts from the dealer when required. Some Mitsubishi-designated parts differ from the maker's standard parts. Thus, confirm the part name, robot arm and controller serial No. and purchase the parts from the dealer.

Table 5-7 : Consumable part list

No.	Part name	Type	Usage place	Q'ty	Supplier
1	Grease		Reduction gears of each axis	An needed	Mitsubishi Electric
2	Lithium battery	A6BAT	In base	5	
3	Liquefied gasket		Packing Note1)	An needed	
RH-3FH series					
4	Timing belt		J3 axis	1	Mitsubishi Electric
5			J4 axis motor side	1	
6			J4 axis shaft side	1	
RH-6FH series					
7	Timing belt		J3 axis	1	Mitsubishi Electric
8			J4 axis motor side	1	
9			J4 axis shaft side	1	

Note1)The liquefied gasket is necessary for the place which uses two or more packings to connect.

Table 5-8 : Spare parts list

No.	Names	Usage place	Q'ty	Supplier
RH-3FH series				
1	AC servo motor	J1 axis	1	Mitsubishi Electric
2		J2 axis	1	
3		J3 axis	1	
4		J4 axis	1	
5	Reduction gears	J1 axis	1	
6		J2 axis	1	
7	Ball screw spline	J3 axis (General environment specification)	1	
8		J3 axis (clean and oil mist specification)	1	
9	Bellows	J3 axis (oil mist specification)	1	
10		J3 axis (clean specification)	1	
11	Liquid gasket	Bellows (clean specification)	An needed	
RH-6FH series				
12	AC servo motor	J1 axis	1	Mitsubishi Electric
13		J2 axis	1	
14		J3 axis	1	
15		J4 axis	1	
16	Reduction gears	J1 axis	1	
17		J2 axis	1	
18	Ball spline	J3 axis (General environment specification)	1	
19		J3 axis (clean and oil mist specification)	1	
20	Ball screw	J3 axis (General environment, clean and oil mist specification)	1	
21	Bellows	J3 axis (oil mist specification)	1	
22		J3 axis (clean specification)	1	
23	Liquid gasket	Bellows (clean specification)	An needed	

5.6 Resetting the origin

The origin is set so that the robot can be used with a high accuracy. After purchasing the robot, always carry out this step before starting work. The origin must be reset if the combination of robot and controller being used is changed or if the motor is changed causing an encoder area. The types of origin setting methods are shown in Table 5-9.

[Caution] If the old battery is replaced because it has been used up, it is necessary to set the origin again.Reset the origin using the jig method or mechanical stopper method or ABS origin method.

.

Table 5-9 : Origin setting method

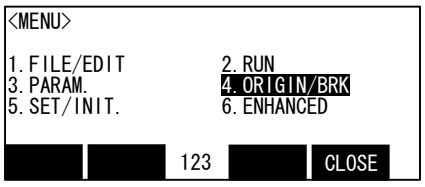
No	Method	Explanation	Remarks
1	Origin data input method	The origin data set as the default is input from the T/B.	The setting method is explained in Page 20, "2.3 Setting the origin" .
2	Mechanical stopper method	This origin posture is set by contacting each axis against the mechanical stopper.	The setting method is explained in Page 89, "5.6.1 Mechanical stopper method" .
3	Jig method	The origin posture is set with the calibration jig installed.	The setting method is explained in Page 97, "5.6.2 Jig method" .
4	User origin method	A randomly designated position is set as the origin posture.	The setting method is explained in Page 104, "5.6.4 User origin method".
5	ABS origin method	This method is used when the encoder backup data lost in the cause such as battery cutting.	Before using this method, the origin must be set with the other method with same encoder. The setting method is explained in Page 102, "5.6.3 ABS origin method".

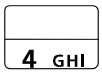
5.6.1 Mechanical stopper method

The method for setting the origin with the transportation jig is explained below.
This operation is carried out with the T/B. Set the mode of the controller to "MANUAL", and set the T/B [ENABLE] switch to "ENABLE" to validate the T/B.

⚠ CAUTION The brakes are released here, and the J3 axis (shaft) is moved with both hands. For safety purposes, the brakes must be released by two workers.

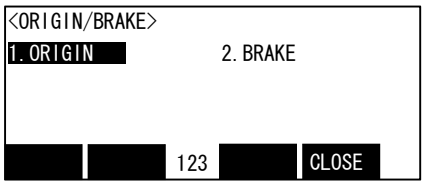
(1) J1 axis origin setting(mechanical stopper)

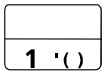




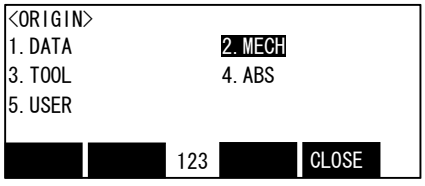
1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

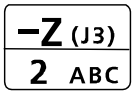
2) With both hands, slowly move the J1 axis in – (minus) direction , and contact the axis against the mechanical stopper.



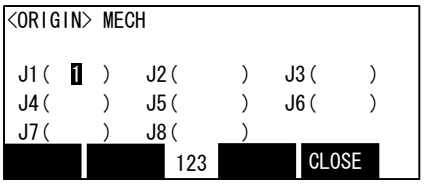


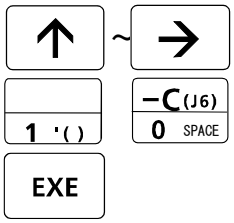
3) Press the [1] key, and display the Origin setting selection screen.





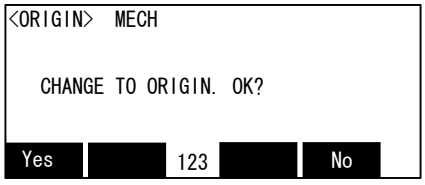
4) Press the [2] key, and display the Mechanical stopper selection screen.





5) Input "1" into the J1 axis. Set "0" to other axes.

6) Press the [EXE] key , and display Confirmation screen.



7) Press the [F1] key , and the origin position is set up.

8) Setting of the origin is completed.

9) Refer to Page 106, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

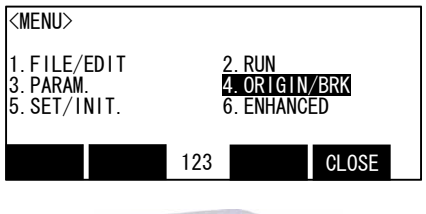
◇◆◇ Release the brake ◇◆◇

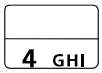
Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is detached while the brakes are released, the brakes will be work immediately.

◇◆◇ Select the axis of origin setting ◇◆◇

Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

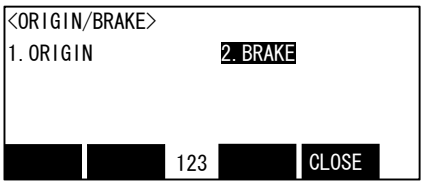
(2) J2 axis origin setting(mechanical stopper)

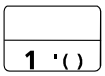




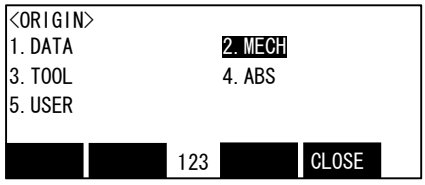
1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

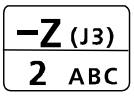
2) With both hands, slowly move the J2 axis in + (plus) direction , and contact the axis against the mechanical stopper. J



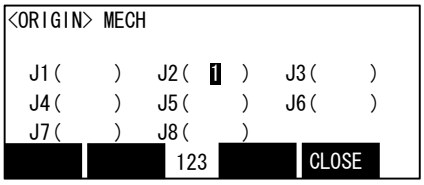


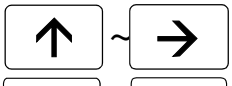
3) Press the [1] key, and display the Origin setting selection screen.

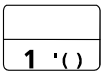


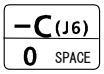


4) Press the [2] key, and display the Mechanical stopper selection screen.



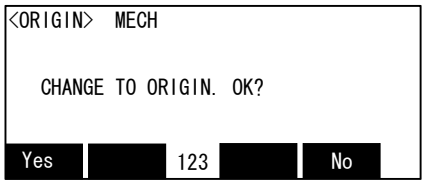






5) Input "1" into the J2 axis. Set "0" to other axes.

6) Press the [EXE] key , and display Confirmation screen.



F1

7) Press the [F1] key, and the origin position is set up.

8) Setting of the origin is completed.

9) Refer to Page 106, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

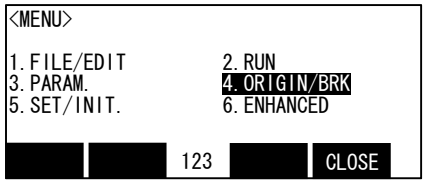
◇◆◇ Release the brake ◇◆◇

Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is detached while the brakes are released, the brakes will be work immediately.

◇◆◇ Select the axis of origin setting ◇◆◇

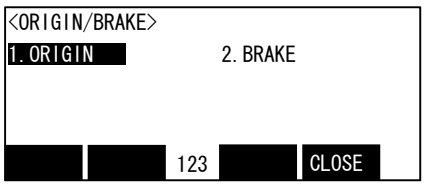
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(3) J3 and J4 axis origin setting (mechanical stopper)



4 GHI

1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.



−Z (J3)
2 ABC

2) Press the [2] key, and display the Break release selection screen.

↑ ~ →

1 '( )

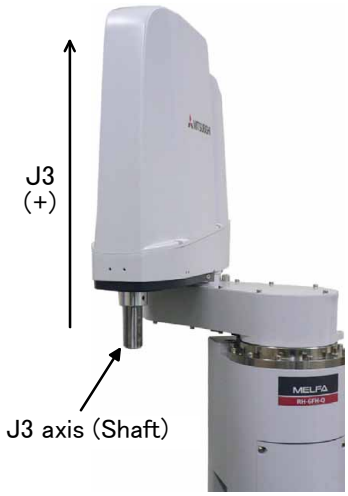
−C (J6)
0 SPACE

3) Release the brake of the J3 axis.
Input "1" into the J3 axis. Set "0" to other axes.

4) Confirm the axis for which the brakes are to be released.

F1

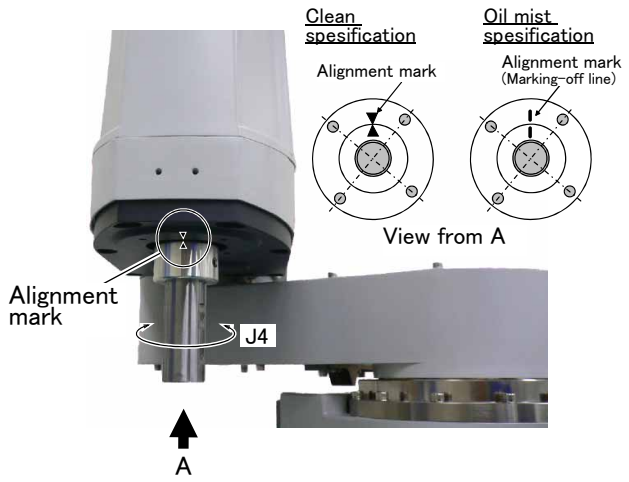
5) Pressing the [F1] key is kept with the enabling switch of T/B pressed down. The brake is released while pressing the key.
Note) The brake of the axis shown below repeats release/lock at the interval in each about 200ms for dropping the J3 axis slowly.



6) With both hands, slowly move the J3 axis in + (plus) direction , and contact the axis against the mechanical stopper.

⚠ CAUTION For safety purposes, the step for releasing the brakes must be carried out by two workers. One worker must operate the T/B, and the other must support the J3 axis (shaft). When the brake is released, the J3 axis could drops with its own weight.

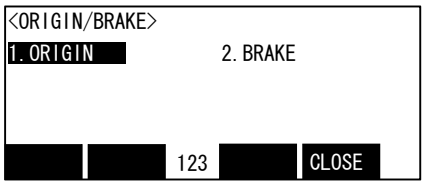
⚠ CAUTION If [F1] key or enable switch of T/B is released, the brakes will be work immediately.



7) Hold the J4 axis with your hand and rotate it slowly to match the alignment marks.
*Move the J4 axis with maintaining the condition that the releasing brake of the J3 axis and the J3 axis contact to the mechanical stopper.

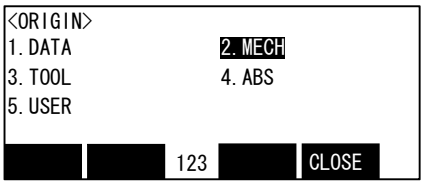
F4

8) Detach the [F1] key and work the brake.
Press the [F4] key and return to the origin / brake screen.



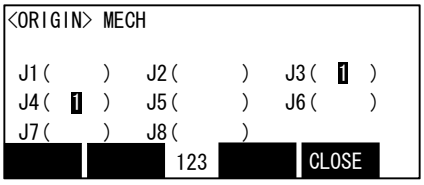
1 '()

9) Press the [1] key , and display the Origin setting selection screen.



−Z (J3)
2 ABC

10) Press the [2] key , and display the Mechanical stopper selection screen.



↑ ~ →

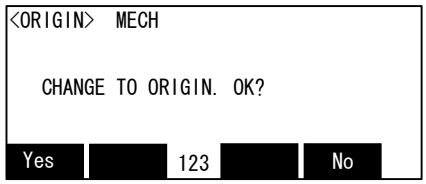
1 '()

−C (J6)
0 SPACE

EXE

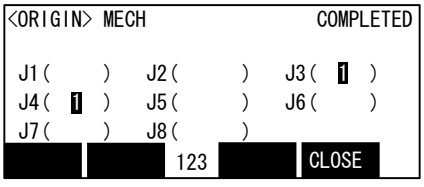
11) Input "1" into the J3 and J4 axis. Set "0" to other axes.

12) Press the [EXE] key , and display Confirmation screen.



F1

13) Press the [F1] key , and the origin position is set up.



14) Setting of the origin is completed.

15) Refer to Page 106, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Release the brake ◇◆◇

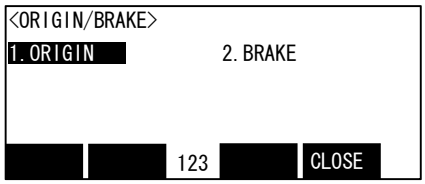
Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is detached while the brakes are released, the brakes will be work immediately.

◇◆◇ Select the axis of origin setting ◇◆◇

Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

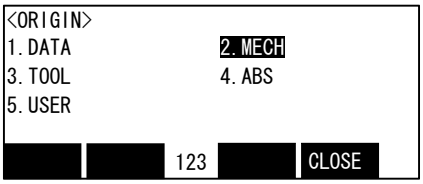
(4) All axis origin setting

1) Refer to the paragraphs from Page 89, "(1) J1 axis origin setting(mechanical stopper)" to Page 93, "(3) J3 and J4 axis origin setting (mechanical stopper)" above for the description of how to adjust the origins of the J1 to J4 axes. Line up the ABS marks for the J4 axis and move the other axes into contact with the mechanical stoppers. At this point, the robot will have the posture shown below



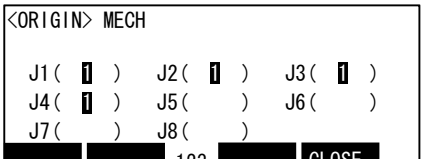
1 '( )

2) Press the [1] key, and display the Origin setting selection screen.



+Z (J3)
3 DEF

3) Press the [2] key, and display the Mechanical stopper selection screen.



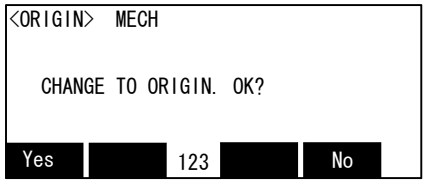
1 '( )

−C (J6)
0 SPACE

4) Input "1" into the J1 to J4 axis. Set "0" to other axes.

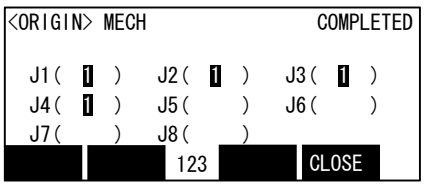
EXE

5) Press the [EXE] key, and display Confirmation screen.



F1

6) Press the [F1] key, and the origin position is set up.



7) Setting of the origin is completed.

8) Refer to Page 106, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

5.6.2 Jig method

This method is using the origin setting tool. If the origin setting tool is required, please ask nearby dealer. The reference figure of the origin setting tool is shown in Fig. 5-20.

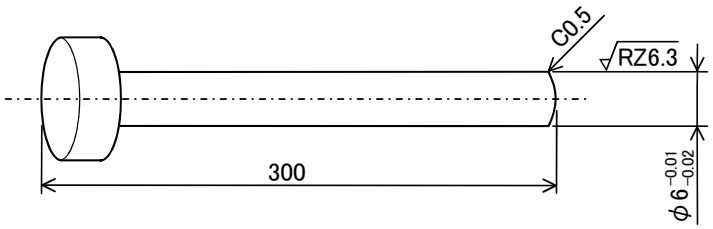


Fig.5-20 : Reference dimension of origin setting tool

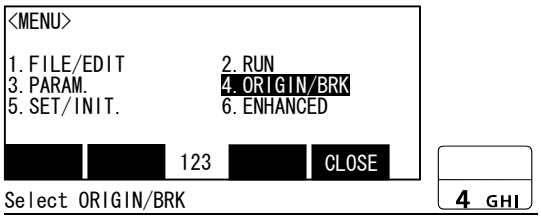
The procedure of setting the origin with the origin setting tool is shown below.

Carry out this method for each axis.
First, set each axis by the origin position. There are the method of releasing the brake and adjusting with the origin position manually and the method of adjusting with the origin position by jog feed. Here, explain operation by brake release.
Then, do origin setting operation and set up the origin.

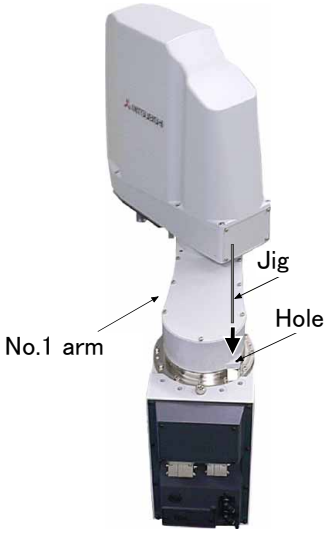
⚠ CAUTION To ensure safety, the brake-release procedure described below should always be done by two persons.

This operation is carried out with the teaching pendant. Set the mode of the controllerdrive unit to "MANUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
Do the following operations, pressing down the enabling switch of T/B lightly.

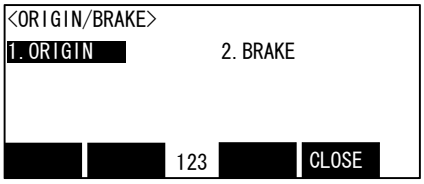
(1) J1 axis origin setting



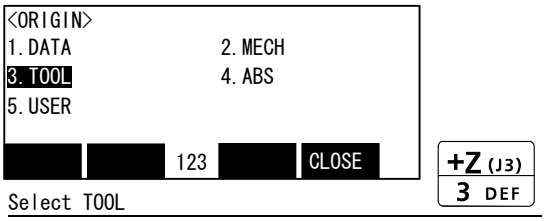
1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.



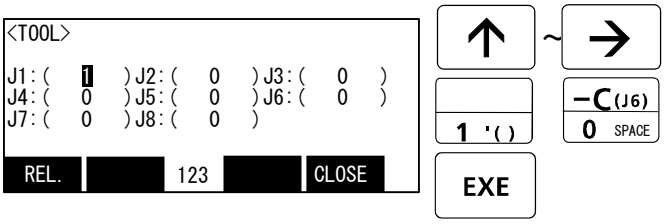
2) Move the J1 axis slowly toward the front using both hands. Align the pinhole of the No.1 arm and the pinhole at the base section, feed through the origin jig into the pinholes and fasten.



3) Press the [1] key, and display the Origin setting selection screen.

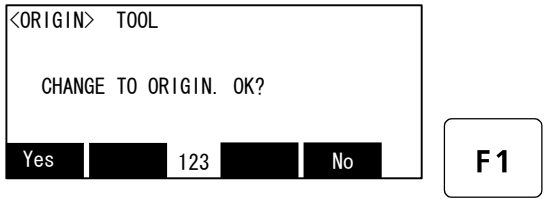


4) Press the [3] key, and display the Tool selection screen.

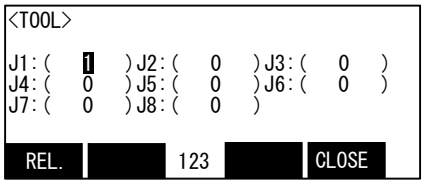


5) Input "1" into the J1 axis. Set "0" to other axes.

6) Press the [EXE] key, and display Confirmation screen.



7) Press the [F1] key, and the origin position is set up.



8) Setting of the origin is completed.

9) Refer to Page 106, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

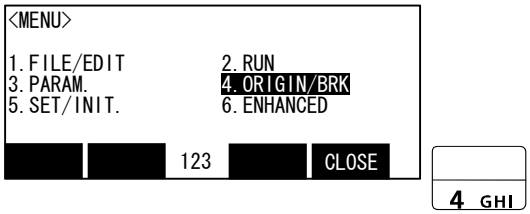
◇◆◇ Release the brake ◇◆◇

Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is detached while the brakes are released, the brakes will be work immediately.

◇◆◇ Select the axis of origin setting ◇◆◇

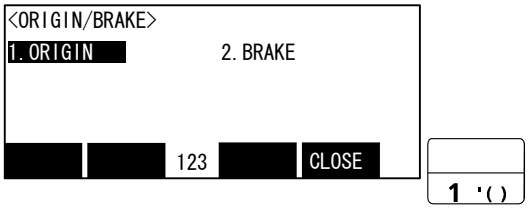
Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(2) J2 axis origin setting

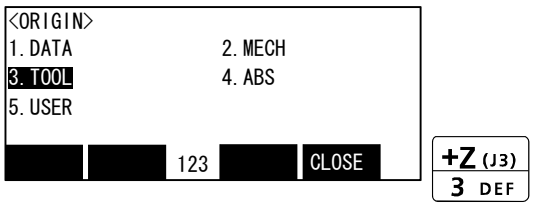


1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

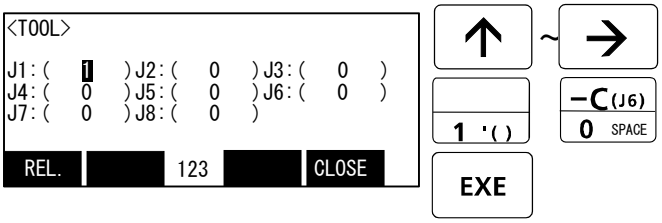
2) Slowly rotate the J2 axis 90° clockwise with both hands for RH-6FH series. Slowly rotate. Align the pinholes of the No. 1 and No. 2 arms, feed through the origin jig into the pinholes and fasten.



3) Press the [1] key, and display the Origin setting selection screen.

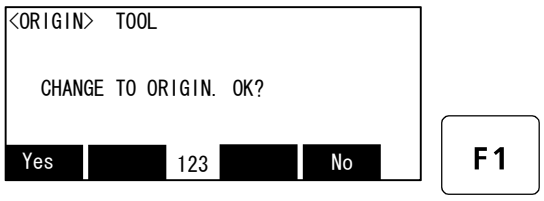


4) Press the [3] key, and display the Tool selection screen.



5) Input "1" into the J2 axis. Set "0" to other axes.

6) Press the [EXE] key, and display Confirmation screen.



7) Press the [F1] key, and the origin position is set up.

8) Setting of the origin is completed.

9) Refer to Page 106, "5.6.5 Recording the origin data" in this manual, and record the origin data on the origin data seal.

◇◆◇ Release the brake ◇◆◇

Do cursor movement into the parenthesis of each axis by the arrow key. The brakes can be released only for the axis for which a "1" is displayed on the screen. If the brakes are not to be released, press the [0] key and display a "0". If the [F1] key on the teaching pendant or the enabling switch is detached while the brakes are released, the brakes will be work immediately.

◇◆◇ Select the axis of origin setting ◇◆◇

Do cursor movement into the parenthesis of each axis by the arrow key. The origin is set only for the axis for which a "1" is displayed on the screen. If the origin is not to be set, press the [0] key and display a "0".

(3) J3 and J4 axis origin setting

Origin settings for the J3 and J4 axes must be performed at the same time.

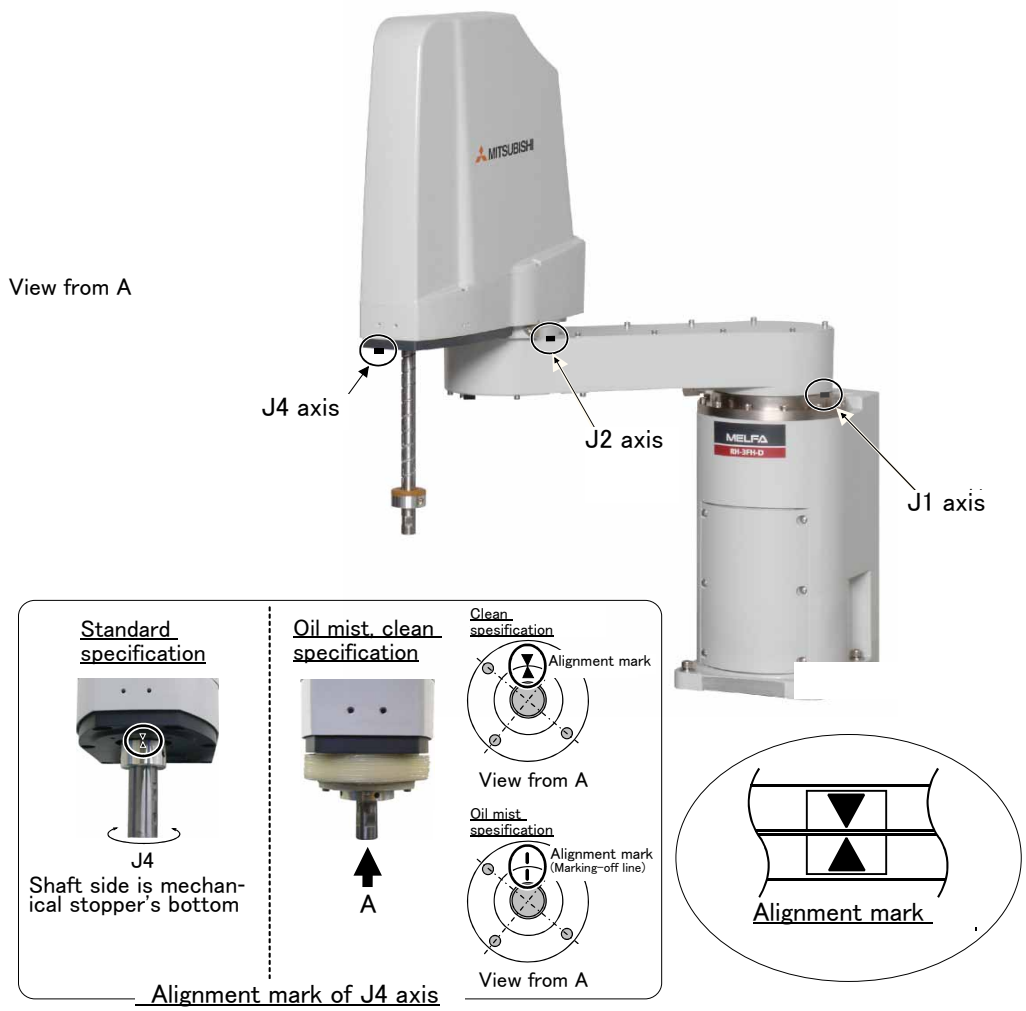
The method of origin setting is the same as the mechanical stopper method. Refer to Page 93, "(3) J3 and J4 axis origin setting (mechanical stopper)", perform the required origin setting operations.

5.6.3 ABS origin method

When the origin setting of the robot is performed for the first time, this product records the angular position of the origin within one rotation of the encoder as the offset value. If the origin setting is performed according to the ABS origin method, this value is used to suppress variations in the origin setting operations and to reproduce the initial origin position accurately.

This operation is carried out with the teaching pendant. Set the mode of the controllerdrive unit to "MANUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
First, set to the ABS mark arrow of the axis for which the origin is to be set with jog operation. This can be set for all axes simultaneously or each axis independently.
When setting the ABS mark, always view the operations from the mark, and set at the end of the triangular mark.
The positions where the ABS mark is attached are shown in below. Refer to Page 26, "2.4 Confirming the operation" for details on the jog operation.

Note that if the ABS marks are peeled off, the positions can be matched using the following alternative methods.
*Match the ruling lines of the ABS mark mounting position surfaces.

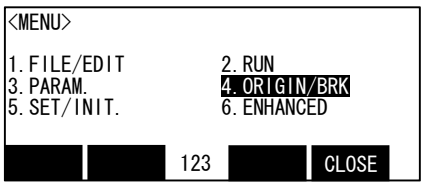


Note) There is no alignment mark of the J3 axis. Contact the J3 axis against mechanical stopper as the mechanism stopper method.

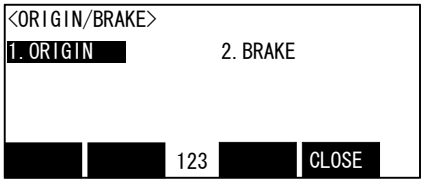
Fig.5-21 : ABS mark attachment positions

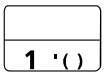
The procedures for setting the origin with the ABS method are explained below.

(1) Select the T/B

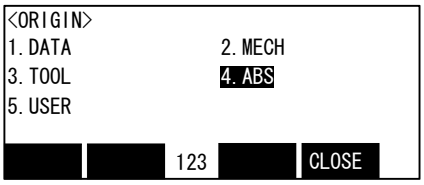


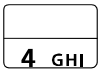
1) Press the [4] key on the menu screen, and display the Origin/Break selection screen.



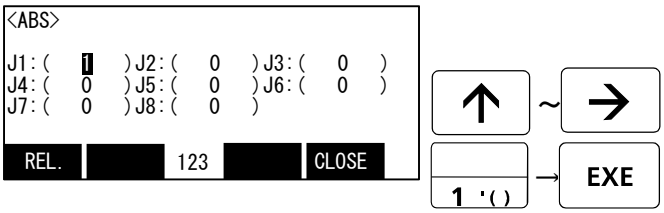


2) Press the [1] key, and display the Origin setting selection screen.

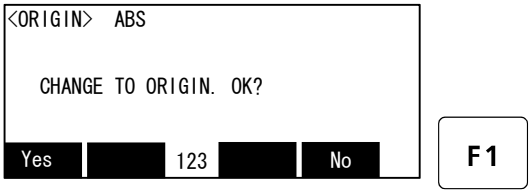




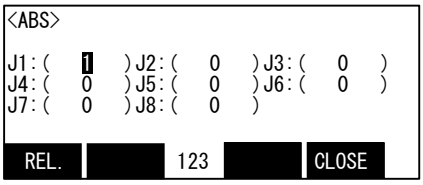
3) Press the [4] key, and display the ABS selection screen.



4) Input "1" into the axis to origin setting. Press the [EXE] key, and display Confirmation screen.



5) Press the [F1] key, and the origin position is set up.



This completes the setting of the origin with the ABS method.

5.6.4 User origin method

CAUTION Before using this method, the origin must be set with the other method.
The setting method is explained in Page 88, "Table 5-9 : Origin setting method".

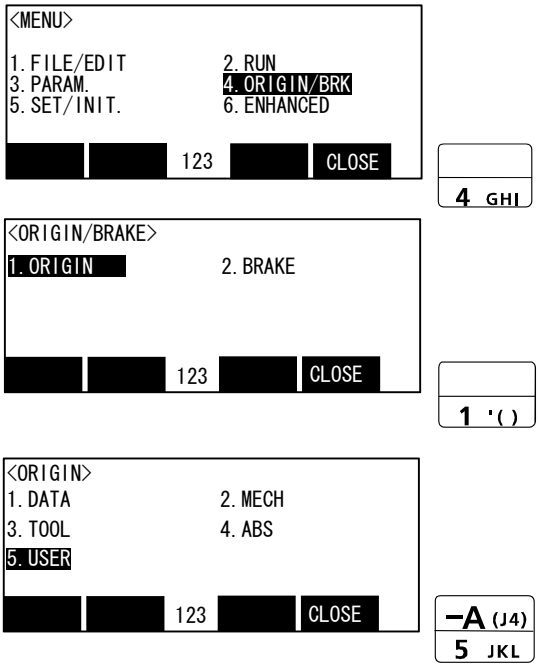
The procedure for setting the origin with the user origin method is explained below.
This operation is carried out with the teaching pendant. Set the mode of the controllerdrive unit to "MAMNUAL", and set the [ENABLE] switch on the teaching pendant to "ENABLE" to enable the teaching pendant.
The operation method is shown below.

When setting the origin for the first time using this method, carry out the operations in order from step 1). For the second and following time, move the robot arm to the user origin position with jog operation, and accurately position all axis. Then start the procedure from step 4).

1) Determine the user origin position
   Move the robot to the position to be set as the origin with jog operation. Refer to Page 26, "2.4 Confirming the operation" for details on the jog operation.

CAUTION Choose the user origin position as the position where it doesn't move by the gravity. This position is left as a guideline to position all axes with jog operation when setting the origin again with this method.

2) Enter the JOINT jog mode, and display the joint coordinates on the teaching pendant screen. Record the value of the axis for which the origin is to be set.
3) Input the value recorded in the "user designated origin parameter (USRORG)".
   The parameter details and input methods are described in the separate "Instruction Manual/Detailed Explanation of Functions and Operations". Refer to that manual and input the user designated origin position.

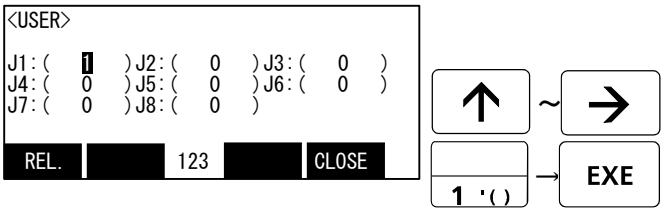


4) Next, set the origin.
   Display the menu screen.

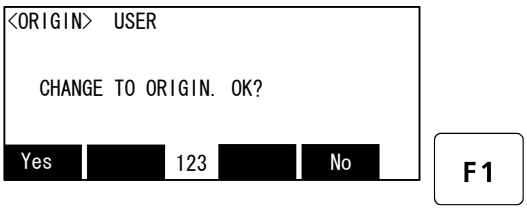
5) Press the [4] key on the menu screen, and display the Origin/Break selection screen.

6) Press the [1] key, and display the Origin setting selection screen.

7) Press the [5] key, and display the User selection screen.



8) Input "1" into the axis to origin setting. Press the [EXE] key, and display Confirmation screen.



9) Press the [F1] key, and the origin position is set up.

This completes the setting of the origin with the user origin method.

5.6.5 Recording the origin data

When the origin has been set with the jig method, record that origin data on the origin data label. With this, the origin can be set with the origin data input method the next time.

Confirm the origin data on the teaching pendant screen (origin data input screen). The origin data label is enclosed with the arm or attached on the back of the battery cover.
The teaching pendant operation method and battery cover removal method for confirming the origin data is the same as the methods for setting the origin with the origin data input method. Refer to Page 21, "2.3.2 Setting the origin with the origin data input method", and write the origin data displayed on the teaching pendant onto the origin label.

(1) Confirming the origin data label
Remove the battery cover.
Refer to Page 62, "5.3.2 Installing/removing the cover", and remove the .

(2) Confirming the origin data
Confirm the value displayed on the teaching pendant's Origin Data Input screen.
Refer to Page 21, "2.3.2 Setting the origin with the origin data input method", "(5)Inputting the origin data" and display the Origin Data Input screen on the teaching pendant display screen.

(3) Recording the origin data
Write the origin data displayed on the teaching pendant to the origin data label attached to the back of the battery cover. Refer to Page 21, "Fig.2-14 : Origin data label (an example)", and Page 24, "Fig.2-15 : Correspondence of origin data label and axis" for details on the origin data label.

(4) Installing the cover
Install the battery cover removed in step "(1)Confirming the origin data label" above.
Refer to Page 62, "5.3.2 Installing/removing the cover", and replace the battery cover.

This completes the recording of the origin data.

6 Appendix

Appendix 1 : Configuration flag

The configuration flag indicates the robot posture.
For the 6-axis type robot, the robot hand end is saved with the position data configured of X, Y, Z, A, B and C. However, even with the same position data, there are several postures that the robot can change to. The posture is expressed by this configuration flag, and the posture is saved with FL1 in the position constant (X, Y, Z, A, B, C) (FL1, FL2).
The types of configuration flags are shown below.

(1) RIGHT/LEFT

Indicates the location of the end axis relative to the line that passes through both the rotational center of the J1 axis and the rotational center of the J2 axis.

Fig.6-1 : Configuration flag (RIGHT/LEFT)

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE: TOKYO BUILDING, 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
NAGOYA WORKS: 5-1-14, YADA-MINAMI, HIGASHI-KU, NAGOYA 461-8670, JAPAN

Authorised representative:
MITSUBISHI ELECTRIC EUROPE B.V. GERMANY
Gothaer Str. 8, 40880 Ratingen / P.O. Box 1548, 40835 Ratingen, Germany

Mar., 2012 MEE Printed in Japan on recycled paper.
Specifications are subject to change without notice.

HEADQUARTERS

MITSUBISHI ELECTRIC EUROPE B.V. **EUROPE**
German Branch
Gothaer Straße 8
D-40880 Ratingen
Phone: +49 (0)2102 / 486-0
Fax: +49 (0)2102 / 486-1120

MITSUBISHI ELECTRIC EUROPE B.V.-org.sl. **CZECH REP.**
Czech Branch
Avenir Business Park, Radlická 714/113a
CZ-158 00 Praha 5
Phone: +420 - 251 551 470
Fax: +420 (0)251-551-471

MITSUBISHI ELECTRIC EUROPE B.V. **FRANCE**
French Branch
25, Boulevard des Bouvets
F-92741 Nanterre Cedex
Phone: +33 (0)1 / 55 68 55 68
Fax: +33 (0)1 / 55 68 57 57

MITSUBISHI ELECTRIC EUROPE B.V. **IRELAND**
Irish Branch
Westgate Business Park, Ballymount
IRL-Dublin 24
Phone: +353 (0)1 4198800
Fax: +353 (0)1 4198890

MITSUBISHI ELECTRIC EUROPE B.V. **ITALY**
Italian Branch
Viale Colleoni 7
I-20041 Agrate Brianza (MB)
Phone: +39 039 / 60 53 1
Fax: +39 039 / 60 53 312

MITSUBISHI ELECTRIC EUROPE B.V. **POLAND**
Poland Branch
Krakowska 50
PL-32-083 Balice
Phone: +48 (0)12 / 630 47 00
Fax: +48 (0)12 / 630 47 01

MITSUBISHI ELECTRIC EUROPE B.V. **RUSSIA**
52, bld. 3 Kosmodamianskaya nab 8 floor
RU-115054 Moscow
Phone: +7 495 721-2070
Fax: +7 495 721-2071

MITSUBISHI ELECTRIC EUROPE B.V. **SPAIN**
Spanish Branch
Carretera de Rubí 76-80
E-08190 Sant Cugat del Vallés (Barcelona)
Phone: 902 131121 // +34 935653131
Fax: +34 935891579

MITSUBISHI ELECTRIC EUROPE B.V. **UK**
UK Branch
Travellers Lane
UK-Hatfield, Herts. AL10 8XB
Phone: +44 (0)1707 / 27 61 00
Fax: +44 (0)1707 / 27 86 95

MITSUBISHI ELECTRIC CORPORATION **JAPAN**
Office Tower "Z" 14 F
8-12,1 chome, Harumi Chuo-Ku
Tokyo 104-6212
Phone: +81 3 622 160 60
Fax: +81 3 622 160 75

MITSUBISHI ELECTRIC AUTOMATION, Inc. **USA**
500 Corporate Woods Parkway
Vernon Hills, IL 60061
Phone: +1 847 478 21 00
Fax: +1 847 478 22 53

EUROPEAN REPRESENTATIVES

GEVA **AUSTRIA**
Wiener Straße 89
AT-2500 Baden
Phone: +43 (0)2252 / 85 55 20
Fax: +43 (0)2252 / 488 60

Koning & Hartman b.v. **BELGIUM**
Woluwelaan 31
BE-1800 Vilvoorde
Phone: +32 (0)2 / 257 02 40
Fax: +32 (0)2 / 257 02 49

INEA RBT d.o.o. **BOSNIA AND HERZEGOVINA**
Aleja Lipa 56
BA-71000 Sarajevo
Phone: +387 (0)33 / 921 164
Fax: +387 (0)33 / 524 539

AKHNATON **BULGARIA**
4, Andrei Ljapchev Blvd., PO Box 21
BG-1756 Sofia
Phone: +359 (0)2 / 817 6000
Fax: +359 (0)2 / 97 44 06 1

AutoCont C.S. s.r.o. **CZECH REPUBLIC**
Technologická 374/6
CZ-708 00 Ostrava-Pustkovec
Phone: +420 595 691 150
Fax: +420 595 691 199

Beijer Electronics A/S **DENMARK**
Lykkegårdsvej 17
DK-4000 Roskilde
Phone: +45 (0)46/ 75 76 66
Fax: +45 (0)46 / 75 56 26

Beijer Electronics OY **FINLAND**
Peltoie 37
FIN-28400 Ulvila
Phone: +358 (0)207 / 463 540
Fax: +358 (0)207 / 463 541

UTECO **GREECE**
5, Mavrogenous Str.
GR-18542 Piraeus
Phone: +30 211 / 1206 900
Fax: +30 211 / 1206 999

AXICONT AUTOMATIKA Kft. **HUNGARY**
(ROBOT CENTER) Reitter F. U. 132
HU-1131 Budapest
Phone: +36 1 / 412-0882
Fax: +36 1 / 412-0883

ALFATRADE Ltd. **MALTA**
99, Paola Hill
Malta- Paola PLA 1702
Phone: +356 (0)21 / 697 816
Fax: +356 (0)21 / 697 817

HIFLEX AUTOM.TECHNIEK B.V. **NETHERLANDS**
Wolweverstraat 22
NL-2984 CD Ridderkerk
Phone: +31 (0)180 – 46 60 04
Fax: +31 (0)180 – 44 23 55

EUROPEAN REPRESENTATIVES

Koning & Hartman b.v. **NETHERLANDS**
Haarlerbergweg 21-23
NL-1101 CH Amsterdam
Phone: +31 (0)20 / 587 76 00
Fax: +31 (0)20 / 587 76 05

Beijer Electronics AS **NORWAY**
Postboks 487
NO-3002 Drammen
Phone: +47 (0)32 / 24 30 00
Fax: +47 (0)32 / 84 85 77

Fonseca S.A. **PORTUGAL**
R. João Francisco do Casal 87/89
PT - 3801-997 Aveiro, Esgueira
Phone: +351 (0)234 / 303 900
Fax: +351 (0)234 / 303 910

SIRIUS TRADING & SERVICES SRL **ROMANIA**
Aleea Lacul Morii Nr. 3
RO-060841 Bucuresti, Sector 6
Phone: +40 (0)21 / 430 40 06
Fax: +40 (0)21 / 430 40 02

INEA RBT d.o.o. **SERBIA**
Izletnicka 10
SER-113000 Smederevo
Phone: +381 (0)26 / 615 401
Fax: +381 (0)26 / 615 401

SIMAP s.r.o. **SLOVAKIA**
Jána Derku 1671
SK-911 01 Trencín
Phone: +421 (0)32 743 04 72
Fax: +421 (0)32 743 75 20

PROCONT, spol. s r.o. Prešov **SLOVAKIA**
Kúpelná 1/A
SK-080 01 Prešov
Phone: +421 (0)51 7580 611
Fax: +421 (0)51 7580 650

INEA RBT d.o.o. **SLOVENIA**
Stegne 11
SI-1000 Ljubljana
Phone: +386 (0)1 / 513 8116
Fax: +386 (0)1 / 513 8170

Beijer Electronics Automation AB **SWEDEN**
Box 426
SE-20124 Malmö
Phone: +46 (0)40 / 35 86 00
Fax: +46 (0)40 / 93 23 01

Robotronic AG **SWITZERLAND**
Schlachthofstrasse 8
CH-8406 Winterthur
Phone: +41 (0)52 / 267 02 00
Fax: +41 (0)52 / 267 02 01

GTS **TURKEY**
Bayraktar Bulvari Nutuk Sok. No:5
TR-34775 Yukarı Dudullu-Ümraniye-İSTANBUL
Phone: +90 (0)216 526 39 90
Fax: +90 (0)216 526 3995

CSC Automation Ltd. **UKRAINE**
4-B, M. Raskovoyi St.
UA-02660 Kiev
Phone: +380 (0)44 / 494 33 55
Fax: +380 (0)44 / 494-33-66

MIDDLE EAST REPRESENTATIVE

ILAN & GAVISH Ltd. **ISRAEL**
24 Shenkar St., Kiryat Arie
IL-49001 Petah-Tiqva
Phone: +972 (0)3 / 922 18 24
Fax: +972 (0)3 / 924 0761

AFRICAN REPRESENTATIVE

CBI Ltd. **SOUTH AFRICA**
Private Bag 2016
ZA-1600 Isando
Phone: + 27 (0)11 / 977 0770
Fax: + 27 (0)11 / 977 0761